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Does the Market Structure of Grape Varieties Impact Exports Performance? a DEA approach

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Abstract

The objective of the paper is to investigate how the market structure of grape varieties affects the performance in the wine industry. We examine the export performance of countries in 2000 and 2010 and analyze the market structure hypothesis applied to grape varieties and the technical efficiency of the market structure of grapes on exports performance using a Data Envelopment Analysis (DEA) methodology. Our results are based on a sample of 20 major wine exporting countries. First, only a few countries are efficient. Second, a small number of prime varieties is not a condition to obtain efficiency. Finally, concentration of top varieties is not sufficient to be efficient.

Keywords: DEA analysis, wine industry; market structure; performance
JEL Classification: C61, D40, L11, L66

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Preamble

> Through its success in the vineyards of Mendoza, in a few short decades Malbec has shot from relative obscurity to international fame, simultaneously bringing new-found attention and respect to Argentina as a wine-producing nation. In France, Malbec is *the* grape of Cahors. The variety has traditionally gone by its local name, Cot, but due to the success of Malbec in Argentina, it is increasingly known by this more internationally recognized name and now mentioned on the labels of Cahors wines. Could the same story be replicated with the Tannat grape in Uruguay and Madiran in France?

1. Introduction

An important way in which countries and producers seek to boost their competitiveness is to exploit their geographical and varietal distinctiveness. The reputation of a country or country-brand is particularly important in the wine industry. The traditional practice of displaying regional names on wine bottle labels is increasingly being supplemented by grape varietal names. Products are characterized by easier recognition and understanding for the consumer than those of European countries, traditional producers, because they are less complex in look and taste. Berrios and Saens (2015) analyze whether or not the reputation of a region/country in the international wine market depends on a region/country's efforts to specialize in a specific grape variety. The purpose of this research is to examine whether or not the specialization into few internationally known variety grapes has an impact on the export performance of countries? Are the European countries penalized by the complexity and multiplicity of their local varieties?

Traditionally, the existence of economies of scale and scope has always been at the heart of agricultural studies but the existence in the viticulture sector is not proved because the "wine" category does not satisfy the condition of uniqueness of the product. The most usual way of testing the market-structure hypotheses has been to introduce concentration and market share as explanatory variables of performance, on the assumption that market share will reflect the effect of efficiency. The literature based on structural approaches has investigated how the market structure affects the productivity, performance and competition among firms (Ball, 1994; Bikker and Haaf, 2002; Burt, 2009; Claessens and Laeven, 2004; Gilson, 1981; Hillston, 1996). In the wine sector, if the market share positively affects performance, and concentration is not significant, the hypothesis of efficiency is not rejected (Outreville, 2015).

Performance could be related to competitiveness in the world market, export growth, quality ratings or reputation. Nowak and Anderson (1999) demonstrate the importance of non-financial performance measures in the wine industry. Numerous studies focused on analyzing the new dynamics of exports and imports in the international market (Anderson, 2001; Bentzen and Smith, 2002; Easingwood, 2007; Bastos and Silva, 2008) but to our knowledge no study has ever investigated the relationship between export performance and market structure. The objective of this paper is to examine the relationship between the market structure of grape varieties and export performance in the wine industry.

In this study, we follow this approach and use published data on worldwide grape varieties in main countries producing wine. Thus, in the first part of the empirical analysis we calculate the impact of market shares of the top grape varieties and market concentration of varieties on the export performance of countries. We then use standard Data Envelopment Analysis (DEA) to compute the efficiencies of wine exports when market shares of grape varieties is considered as a decision making unit. To estimate the production frontier of Decision Making Units (DMUs) export performance is the output variable and we use variables related to the market structure of grape varieties as inputs.

The remainder of this paper is structured as follows. The next section presents the data. Section 3 describes the methodology as well as our hypotheses. Section 4 reports results and describes managerial implications. The final section concludes.

2. Data

The raw data used in this paper are presented by Anderson and Aryal (2013) and provide a brief guide to the types of information compiled in this new database and in an accompanying e-book. Three countries, Spain, France and Italy, account for 54% of the world's winegrape vineyard area in both 2000 and 2010. The same three countries also dominate global wine production and exports. In many countries the dominant grape variety represents less than 20% market share but some major producing countries like New Zealand have a high concentration of the vineyard into a single grape (52.3% for Sauvignon Blanc in New Zealand).[1]

[1] See Anderson (2010).

The extent of varietal concentration in the world's vineyard has increased over the decade to 2010. In red varieties, Cabernet Sauvignon and Merlot dominate the world's vineyard while in white varieties, with the exception of Airen, only planted in Spain, Chardonnay and Sauvignon Blanc are the dominant grapes (See appendix 1 for statistics on grape varieties).

For each country we know the area of production and the number of prime varieties and we calculate the level of concentration of grape varieties using market shares and Herfindahl indices. We also collect information of the level of production in 2000 and 2010 and the level of exports for 2000 and 2010. Because of data availability the sample is limited to the 20 major exporting countries representing in 2010 about 95% of the world exports. Table 1 reports the descriptive statistics.[2]

Insert table 1 here

Table 1. Descriptive statistics

2000							
	Number of prime varieties	Area (hectares)	Top variety (%)	Top 3 (%)	Top 5 (%)	Top 10 (%)	Exports (1,000hl)
MIN	8	8880	7.04	17.55	24.38	33.95	25
MAX	323	1181805	52.76	79.12	89.26	100.00	15039
MEAN	72.4	220545	22.79	45.25	57.32	72.83	2878
SD	86	309811	11.36	16.99	18.25	19.02	4531
2010							
	Number of prime varieties	Area (hectares)	Top variety (%)	Top 3 (%)	Top 5 (%)	Top 10 (%)	Exports (1,000hl)
MIN	16	7657	9.68	21.62	30.32	40.59	29
MAX	396	1028258	52.76	79.12	89.26	94.05	21482
MEAN	94	208943	23.45	46.03	58.80	74.86	4514
SD	92.6	283180	12.59	16.93	17.69	16.92	6162

[2] Countries: Argentina, Australia, Austria, Brazil, Bulgaria, Canada, Chile, Czech Republic, France, Germany, Greece, Hungary, Italy, New Zealand, Portugal, Romania, South Africa, Spain, United States, Uruguay.

Between 2000 and 2010 the number of prime varieties for the sample of 20 countries increased on average by 30%. Indeed, in eleven countries this number is increasing significantly. This increase is very high notably in Uruguay, Brazil, Hungary, Portugal, Canada and Argentina. France is the only country where the number of major prime varieties is strongly decreasing over the period followed by Germany. Italy presents the highest number of prime varieties in 2000 (323) followed by France (285) and in 2010 (396) followed by Portugal (266). The area in hectares for the same group of countries decreased slightly by 5% during the same period. Most of the countries have diminished their producing area with the exception of New Zealand (221 % increase).

Exports increased between 2000 and 2010 by 57 % on average. This increase is the highest in Romania (+ 1478 %), Brazil (+ 878 %), New Zealand (+ 689 %) and Bulgaria (+ 377 %). This trend is also true in two of the three major export countries, i.e. Italy (+ 46 %) and Spain (+ 98 %). France, an exception with exports decreasing by 7.75 %, lost its first place in 2010 to the benefit of Italy and Spain. Chile (+ 176 %) and Australia (+ 151 %) also reported a high increase during the same period.

On average during the same period, the market share of the top varieties remained slightly identical. By country, there is a large disparity in the evolution of the market share of the top 1, 3 and 5 varieties. The market shares of the top 3 varieties increased significantly in Australia, Brazil, Hungary, New Zealand and Portugal. Nine countries reported an increased market share for their top varieties while eight countries reported a decreased market share, notably Austria, The Czech Republic, Greece and South Africa.

3. Methodology

The Structure–Conduct–Performance (SCP) hypothesis expects more concentrated markets to have the capacity to earn higher profits and posits a positive relationship between concentration and performance (Stigler, 1964), i.e. the market share (MS) variable should have only a small impact (at best), and efficiency effects should be small or insignificant. Alternatively, the Efficiency-Structure (ES) hypothesis posits that concentration of the market is the result of greater efficiency (Demsetz, 1973; Phillips, 1976 and Gale and Branch, 1982). In this case, the positive correlation between performance and concentration is spurious, and a positive relationship between MS and performance should be the consequence of efficiency.

Traditionally, the most usual way of testing both hypotheses has been to introduce concentration and MS as explanatory variables of performance, on the assumption that MS will reflect the effect of efficiency. In this case, if the MS positively affects performance, and concentration is not significant, the hypothesis of efficiency is not rejected.

To test the SCP hypothesis, the first static measure is the well-known Herfindahl-Hirschman concentration index calculated with the market shares (qi) of all companies in a market:

$$H = \Sigma [qi]^2$$

The advantage of this measurement is that it makes it possible to calculate a "number equivalent" of companies (N* = 1/H) where N* is the potential number of companies of the same size which could exist on the market for a given degree of concentration.[3]

The relationship with performance is defined as follows:

Performanceπ = *f [CR, MS, X]*

Where CR is the concentration measure of the market, MS is the market share variable (qi) which captures firms' superior efficiency in obtaining a larger portion of the market and Xi are country specific variables to control for other factors.

The alternative approach proposed in this paper is to use standard Data Envelopment Analysis (DEA) to compute the efficiencies of wine exports when market concentration of grape varieties is considered as a decision making unit. DEA is a nonparametric linear programming method that can derive efficiency measures and scores. The details and the motivation of this method have appeared in numerous articles and are detailed notably by Charnes *et al*. (1978), Färe *et al*. (1994) and Thiele and Brodersen (1999). The main advantage of this method is that it can easily accommodate multiple outputs and inputs. Cloutier and Rowley (1993) is probably the first paper applying DEA analysis to agribusiness. With more than 4,000 articles published in the academic literature (Emrouznejad *et al*., 2008), DEA is a linear programming technique widely used in many fields (e.g., agriculture, airline industry, banks, financial services, hospitals, pharmaceutical firms, port, public sector resources, public universities, regional development, sports, and telecom branches).

[3] In the empirical literature, several measures of competition are used among which the Herfindahl index and the Price Cost Margin (or Lerner index) are the most popular ones. See Outreville (2015) for an application in the wine sector.

In wine sector, this method has been used only in a few studies. For example, Day *et al*. (1995) identify both strategic leaders, the 'best practice' players in the industry, and strategic groups to examine the source of the most sustained heterogeneity in the performance of U.S. brewers. Bouzdine-Chameeva (2005) applies the DEA method to analyze the performance of 132 well-known chateaux of the top range. Barros and Santos (2007) use an output oriented technical efficiency index to compare the efficiency of cooperative and private wine enterprises in Portugal. Vidal et al. (2013) analyze the performance efficiency of the Spanish DOs wine using a bounded adjusted DEA measures. Aparicio et al. (2013) calculate the efficiency of 26 Spanish designation of origin basing on the DEA.

DEA method identifies links between inputs and outputs, simple or multiple, in a perspective of relative efficiency. This latter represents the conversion of inputs and outputs in a simple measure of performance named relative efficiency score, which varies between 0 and 1. Relative means that we compare a relative ratio of efficiency compared to the efficiency of other units of the same sample. Calculation of the unit efficiency takes into account of inputs and outputs of all other units of the sample. Thus, the DEA method indicates how one unit compares to other units, determines units that are more efficient, and builds an efficient frontier. These units are used as comparison base and have a relative efficiency score equals to 1. All other units indicating a score lower than one are considered inefficient relative to other units of the comparison group.

The two following hypotheses are considered:
H1: countries having the smallest number of prime varieties are the most efficient in terms of exports.
H2: countries having a high market share of their top grape varieties are more efficient in terms of exports.

4. Results and comments

The first step of the analysis is to compute the market shares of the grape varieties by country and to calculate the Herfindhal index. The level of concentration of grape varieties in 2010 is the highest in New Zealand (table 2) and the level of concentration increased significantly in New Zealand compared to 2000. In Uruguay and Brazil, the level of concentration significantly decreased in 2010 compared to 2000. In all other countries the evolution of the level of concentration was only moderate.

Insert table 2 here

To analyze the impact of market concentration of varieties on the export performance of countries the following equation has been estimated with OLS and the 20 countries of the sample:

(Exports 2010-Exports 2000) = f [CR, MS, Area, Number of varieties, Production]

where CR is the concentration measure of the market structure of grape varieties (the Herfindhal index), MS is the market share variable (qi) of the top grape variety which captures the superior efficiency in obtaining a larger level of exports and other variables like the area, the number of varieties and the level of production are control variables.

Table 2. Herfindhal indices per country

Country	*Herfindhal 2010*	*Herfindahl 2000*
Argentina	0.0816	0.0825
Australia	0.1577	0.1327
Austria	0.1366	0.1755
Brazil	0.1975	0.2276
Bulgaria	0.1290	0.1197
Canada	0.0700	0.0766
Chile	0.1809	0.1777
Czech Republic	0.0597	0.1294
France	0.0668	0.0662
Germany	0.1752	0.1806
Greece	0.0842	0.1300
Hungary	0.0433	0.0543
Italy	0.0346	0.0333
New Zealand	0.3195	0.1747
Portugal	0.0410	0.0441
Romania	0.1005	0.1211
South Africa	0.0983	0.1060
Spain	0.1252	0.1644
United States	0.0915	0.0929
Uruguay	0.1488	0.2656

The results of the analysis are presented in table 3 and show that the level of concentration of grape varieties measured by the Herfindhal index is negative and not significant. On the opposite,

the market share of the top variety positively affects the exports performance, meaning that the hypothesis of efficiency cannot be rejected (table 3). Among the control variables only the area of production and the increase in the production level significantly affect the exports performance of countries. A robustness check is done by extending the sample to 27 countries for which data are available. The results are almost identical and confirm the previous analysis.

Insert table 3 here

Table 3. Regression results

Variable	Coefficient	Std. Error	t-Statistic			Coefficient	Std. Error	t-Statistic	
	n =20					n =27			
Constant	-1513.17	1050.34	-1.44			-1133.75	693.78	-1.63	*
Herfindahl 2010	-293.35	182.9	-1.6			-158.12	125.95	-1.25	
Top variety Market Share	218.93	119.43	1.83	*		128.42	80.94	1.68	*
Number of varieties	2.24	4.43	0.5			3.04	3.60	0.84	
Area	0.011	0.0017	5.98	***		0.01	0.0015	6.94	***
Production (2010-2000)	0.607	0.122	4.95	***		0.594	0.10	5.71	***
Adjusted R-squared	0.73					0.74			
F-statistic	11.39					16.11			
Note: Level of significance: 1% (***), 5% (**),									

The next step is to apply the DEA analysis and to compute the efficiencies of wine exports when the market share of grape varieties is considered as a decision making unit. Considering that in the previous analysis the SCP hypothesis is not validated, in the second step, we analyze the efficiency performance of the market structure of grape varieties. We choose five inputs and one output. We retain as output the exports and as inputs two control variables, i.e. the total area in hectares, the number of prime varieties and in percentage the market share of the top, top 3, and top 5 varieties.

The analysis is performed for the 20 countries in 2000 and 2010. Comparison of the results is presented in table 4 below

Insert table 4 here

Table 4. The DEA analysis of performance for the 20 countries

DEA analysis, year 2000					
Country	Total area	*Prime varieties*	*Top variety*	*Top 3*	*Top 5*
Spain	0.25416	0.58570	0.37246	0.34317	0.37443
France	0.24982	0.74084	0.54143	0.42054	0.39856
Italy	0.52301	0.27780	1.00000	1.00000	1.00000
United States	0.26792	0.15915	0.11921	0.09762	0.09608
Argentina	0.20790	0.12659	0.09468	0.07398	0.07003
Romania	0.00877	0.02007	0.00688	0.00476	0.00459
Portugal	0.24836	0.05133	0.13905	0.11634	0.10501
Australia	0.78392	1.00000	0.14803	0.12921	0.14904
Chile	1.00000	0.69427	0.10682	0.13005	0.13660
Germany	0.58645	0.41917	0.09488	0.09594	0.10895
South Africa	0.57094	0.28512	0.11006	0.09383	0.08683
Hungary	0.18093	0.03095	0.03846	0.03605	0.03508
Bulgaria	0.13651	0.16099	0.01423	0.01150	0.01207
Greece	0.10363	0.03384	0.01081	0.01148	0.01208
Brazil	0.03268	0.00537	0.00153	0.00183	0.00203
Austria	0.20743	0.09071	0.01113	0.01268	0.01398
New Zealand	0.67676	0.16160	0.01492	0.01916	0.02321
Czech Rep.	0.21853	0.03729	0.01283	0.00906	0.00798
Canada	0.22783	0.01017	0.00633	0.00463	0.00433
Uruguay	0.05770	0.00362	0.00065	0.00056	0.00056

DEA analysis, year 2010					
Country	Total area	*Prime varieties*	*Top variety*	*Top 3*	*Top 5*
Spain	0.30750	0.75252	0.17701	0.28658	0.31279
France	0.73048	0.72983	0.86241	0.72711	0.66579
Italy	0.96827	0.62838	1.00000	1.00000	1.00000
Romania	0.04803	0.19517	0.02082	0.02207	0.02202
Portugal	0.39774	0.33557	0.18532	0.18098	0.17790
Argentina	0.17608	0.37611	0.03597	0.03819	0.03687
United States	0.66206	0.45592	0.09131	0.10993	0.10171
Australia	1.00000	1.00000	0.09311	0.09287	0.10135
Chile	0.97569	0.96343	0.05634	0.07718	0.08608
Germany	0.97313	0.58575	0.07561	0.08256	0.09877
Bulgaria	0.34701	0.52228	0.02265	0.02819	0.02776
South Africa	0.63243	0.28679	0.03931	0.05047	0.05327
Hungary	0.38775	0.34663	0.06764	0.06678	0.06622
Brazil	0.05168	0.04732	0.00162	0.00181	0.00216
Greece	0.35504	0.09912	0.01153	0.01615	0.01825
Austria	0.29971	0.14501	0.00645	0.01050	0.01158
Czech Rep.	0.12234	0.04564	0.00148	0.00135	0.00132
New Zealand	0.76055	0.11316	0.00431	0.00464	0.00525
Canada	0.12358	0.01729	0.00146	0.00133	0.00126
Uruguay	0.15611	0.05705	0.00068	0.00075	0.00088

Italy, which is the first exporting country in 2010 and has the higher number of prime varieties (twice more than Spain) is efficient for the market shares of the top varieties. Few countries are efficient, i.e. Chile in 2000 and Australia in 2010, if we consider only the total area; France and Spain with the largest area are not located on the efficient frontier; Italy, Germany and Chile are close to the efficiency frontier in 2010. Except these three countries all countries are inefficient. Chile has multiplied its exports by three between the two dates and has diminished its area while Australia has multiplied its exports by 2.5 for almost the same area.

H1: countries having the smallest number of prime varieties are the most efficient in terms of exports.

This hypothesis would show the importance of the concentration of grape varieties in the measure of performance. On the contrary, this would also mean that countries having significantly increased their number of grape varieties would be less efficient or would increase their distance from the efficient frontier.

We note that with the exception of Australia which is on the efficient frontier with a relatively small number of grape varieties, all countries with a smaller number of prime varieties are strongly inefficient with the exception of Chile in 2010. Among countries which have diminished their number of grape varieties between 2000 and 2010, Germany, France and South Africa remain inefficient with a large distance from the efficient frontier. On the contrary, Italy, with an increased number of grape varieties has significantly increased efficiency.

Considering these results, it is therefore not possible to validate hypothesis H1.

H2: countries having a high market share of their top grape varieties are more efficient in terms of exports.

In this hypothesis, we examine if countries with higher market shares for the top variety, the top 3, and top 5 are the most efficient, i.e., the higher the concentration in a few grape varieties and the greater the efficiency is.

Italy is the only country to be efficient when we take into account the concentration of grape varieties. This country is the first in terms of exports in 2010 but also the country having the largest number of prime varieties and the smallest market shares in top varieties. All countries are inefficient with results lower than 0.20 with the exception of Spain and France with a large number of grape varieties. Typically, countries with the largest market share in a single grape like New Zealand, Chile or Brazil are the least efficient.

This result invalidates the second hypothesis H2.

In order to verify our analysis we split the sample into “old producing countries” and “new producing countries”. The results are similar in 2000 and 2010 for the two sub-groups and only the results for 2010 are presented in table 5 below.

Insert table 5 here

For the group of old producing countries, Italy remains the only country to be on the efficient frontier with a small market share for the top varieties. All other European countries are strongly inefficient with the exception of France.

For the sub-group of the new producing countries, only The United States and Australia single out themselves from the group has been on the efficiency frontier for the market share of their top varieties. Again, New Zealand and Brazil are strongly inefficient.

Table 5. The DEA analysis of performance by sub-groups in 2010

DEA analysis, old producing countries, 2010					
Country	Total area	*Prime varieties*	*Top variety*	*Top 3*	*Top 5*
Spain	0.31599	1.00000	0.17701	0.28658	0.31279
France	0.75065	0.96985	0.86241	0.72711	0.66579
Italy	0.99501	0.83504	1.00000	1.00000	1.00000
Romania	0.04935	0.25935	0.02082	0.02207	0.02202
Portugal	0.40872	0.44593	0.18532	0.18098	0.17790
Germany	1.00000	0.77838	0.07561	0.08256	0.09877
Bulgaria	0.35659	0.69404	0.02265	0.02819	0.02776
Hungary	0.39846	0.46063	0.06764	0.06678	0.06622
Greece	0.36484	0.13172	0.01153	0.01615	0.01825
Austria	0.30798	0.19270	0.00645	0.01050	0.01158
Czech Rep.	0.12572	0.06065	0.00148	0.00135	0.00132

DEA analysis, new producing countries, 2010					
Country	Total area	*Prime varieties*	*Top variety*	*Top 3*	*Top 5*
Argentina	0.17608	0.37611	0.38628	0.34742	0.36251
United States	0.66206	0.45592	0.98068	1.00000	1.00000
Australia	1.00000	1.00000	1.00000	0.84482	0.99642
Chile	0.97569	0.96343	0.60513	0.70206	0.84633
South Africa	0.63243	0.28679	0.42221	0.45913	0.52377
Brazil	0.05168	0.04732	0.01735	0.01644	0.02121
New Zealand	0.76055	0.11316	0.04633	0.04224	0.05160
Uruguay	0.15611	0.05705	0.00732	0.00684	0.00868
Canada	0.12358	0.01729	0.01568	0.01205	0.01242

5. Conclusion

This paper is the first to apply a data envelopment analysis (DEA) methodology to grape varieties and to examine the technical efficiency of the market structure of grape varieties on exports performance. We determine the impact of the market structure of varieties on the efficiency and test whether the level of market concentration can explain variations in country performance. We verify the two traditional hypotheses concerning the relationship between market structure and performance and find that market shares of grape varieties positively affects performance but the concentration level is not significant, i.e. the hypothesis of efficiency is not rejected.

We apply the DEA methodology to discuss whether countries having the highest market shares into few varieties are the most efficient ones in terms of exports. The analysis is provided for the years 2000 and 2010. We find that, first, only few countries are efficient, i.e. are located on the efficient frontier. Second, a weak number of prime varieties do not permit to obtain efficiency. Finally, a high market share of the top varieties is not sufficient to be efficient.

These results provide an interesting point of view in the debate concerning the specialization approach of new producing countries. The results show that neither Argentina, specializing into Malbec nor New Zealand, specializing into Sauvignon Blanc, are efficient in our analysis. A further research could use a higher number of years to develop a dynamic analysis of exports performance.

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Appendix 1: Selected varieties around the world: areas and most popular countries

Red varieties	Area	Nb of countries		Country 1	Country 2	Country 3
Cabernet Sauvignon	290083	40		France (19.44%)	Chile (14.04%)	USA (11.99%)
Merlot	267169	35		France (43.32%)	Italy (10.50%)	USA (8.51%)
Trempranillo	232553	17		Spain (89.30%)	Portugal (7.18%)	Argentina (2.63%)
Syrah	185475	26		France (36.98%)	Australia (23.01%)	Spain (10.78)
Grenache noir	184735	24		France (51.01%)	Spain (37.97%)	Italy (3.45%)
Pinot noir	86655	24		France (34.32%)	USA (19.36%)	Australia (5.41%)
Carignan/Mazuelo	80174	18		France (66.30%)	Tunisia (9.45%)	Algeria (9.42%)
Bobal	80120	1		Spain (100%)		
Sangiovese	77707	15		Italy (92.17%)	France (2.05%)	USA (1.10%)
Monastrell/Mourvèdre	69850	14		Spain (83.62%)	France (13.40%)	Australia (1.00%)
Cabernet Franc	53599	27		France (68.93%)	Italy (11.78%)	USA (4.13%)
Malbec/Cot	40688	19		Argentina (76.31%)	France (15.13%)	Chile (3.11%)
Cinsaut	36040	15		France (57.71%)	Algeria (20.95%)	Morocco (10.93%)
Montepulciano	34947	7		Italy (99.65%)	Argentina (0.24%)	USA (0.08%)
Zinfandel/Tribidrag	32745	13		USA (60.64%)	Italy (37.36%)	Tunisia (1.03%)
Gamay	32671	17		France (93.18%)	Switzerland (4.65%)	Canada (0.67%)
Barbera	24178	11		Italy (84.89%)	USA (11.57%)	Argentina (2.26%)
Nero d'Avola	16596	2		Italy (99.99%)	Argentina (0.01%)	
Blaufrankirsch	16141	12		Hungary (49.55%)	Austria (20.00%)	Czech Rep. (8.54%)
Carmenere	11360	11		Chile (77.70%)	China (11.91%)	Italy (9.45%)
Touriga Nacional	10435	7		Portugal (97.50%)	South Africa (0.10%)	Australia (0.05%)
Nebbiolo	5992	13		Italy (92.39%)	Mexico (3.00%)	Australia (1.63%)
Tannat	5940	12		France (49.06%)	Uruguay (30.56%)	Argentina (11.86%)
White varieties						
Airen	252364	1		Spain (100%)		
Chardonnay	198791	36		France (22.43%)	USA (20.55%)	Australia (13.97%)
Sauvignon blanc	110116	32		France (24.37%)	New Zealand (14.72%)	Chile (11.04%)
Trebbiano/Ugni blanc	109772	14		France (76.42%)	Italy (19.60%)	Argentina (1.75%)
Welschriesling/Graselina	61200	13		Serbia (54.12%)	Romania (12.30%)	Croatia (7.68%)
Rkatsiteli	58641	11		Georgia (43.18%)	Ukraine (19.70%)	Moldavia (19.62%)
Riesling	50060	34		Germany (44.90%)	USA (9.69%)	Australia (8.22%)
Pinot gris	43563	29		Italy (39.67%)	USA (12.01%)	Germany (10.22%)
Macabeo	41046	2		Spain (93.60%)	France (6.40%)	
Cayatena blanca	39741	2		Spain (99.63%)	Portugal (0.37%)	
Aligoté	36119	12		Moldavia (43.72%)	Ukraine (26.65%)	Romania (20.20%)
Chenin blanc	35150	20		South Africa (52.68%)	France (27.96%)	USA (9.16%)
Catarratto bianco	34863	2		Italy (99.80%)	USA (0.20%)	
Muller Thurgau	22753	17		Germany (59.30%)	Hungary (9.22%)	Austria (8.98%)
Semillon	22156	20		France (52.78%)	Australia (27.59%)	South Africa (5.34%)
Gruner Veltliner	18842	8		Austria (71.75%)	Slovakia (11.10%)	Czech Rep. (8.10%)
Pinot blanc	14724	27		Germany (26.28%)	Italy (20.96%)	Austria (13.00%)
Gewurztraminer	14269	26		France (21.60%)	Moldavia (19.14%)	Italy (9.87%)
Chasselas	13186	16		Switzerland (30.44%)	Serbia (26.16%)	France (18.51%)
Feteasca Regala	13136	2		Romania (98.24%)	Slovakia (1.76%)	
Melon	12365	2		France (99.99%)	Argentina (0.01%)	
Viognier	11400	17		France (38.55%)	Australia (12.30%)	USA (12.05%)

Appendix 2: Sample of 20 countries used in the analysis and ranked by exports in 2010

Country	*No. Of prime varieties*	*Area in 2010 (hectares)*	*Top variety in %*	*Name*	*Production 2010*	*Exports 2010*
Italy	396	603543	11.8	Sangiovese	48525	21482
Spain	150	1009186	24.5	Airen	35353	17156
France	96	842085	13.7	Merlot	44381	13888
Australia	40	149382	28.6	Syrah	11420	7811
Chile	54	111305	36.5	Cabernet	8844	7321
United States	129	121856	18.4	Chardonnay	20887	4009
Germany	48	67990	33.1	Riesling	6906	3929
South Africa	68	100983	18.3	Chenin blanc	9327	3786
Argentina	111	201043	15.4	Malbec	16250	2744
Portugal	266	162126	10.2	Tempranillo	7133	2666
New Zealand	45	30966	52.3	Sauvignon	1900	1420
Hungary	137	65603	12.2	Blaufrankirsch	1762	828
Austria	35	44207	29.7	Gruner Vertliner	1737	620
Bulgaria	16	46936	22.5	Merlot	1224	503
Greece	56	45360	21.8	Savatiano	2950	370
Czech Republic	32	15900	9.7	Muller Thurgau	564	233
Canada	76	9956	11.8	Chardonnay	550	151
Brazil	101	47318	38.6	Isabella	2459	106
Romania	25	79547	16.2	Feteasca	3287	98
Uruguay	41	7140	25.4	Tannat	769	29