

# **Which Winegrape Varieties are Grown Where?**

## A Global Empirical Picture

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## Authors' preface and acknowledgements

Over the past 15 years the University of Adelaide has provided numerous editions of a global statistical compendium of annual time series data and various key indicators of national markets for grape wines. The eighth version was published by the University of Adelaide Press in 2011 as a book and e-book ([www.adelaide.edu.au/press/titles/global-wine](http://www.adelaide.edu.au/press/titles/global-wine)) and the data are freely available at the University's Wine Economics Research Centre ([www.adelaide.edu.au/wine-econ/databases](http://www.adelaide.edu.au/wine-econ/databases)). However, very little of the data in that compendium relate to the grapes that are the key ingredient in winemaking. Nor are data included by wine region within each of the countries covered. One reason is space: that compendium is already 500 pages long, so subdividing each country's area and production data into regions would have turned the volume into a brick. Also, the readily available annual data for grapes do not distinguish winegrapes from grapes for fresh consumption or drying. The more-detailed data sets that focus specifically on winegrape area data by region and variety are far less frequently published in most countries.

Another reason for that compendium including little information on winegrapes is that the relatively scant data on bearing area (and the even scarser data on winegrape production, yield and price) refer to varieties that have different names in different countries – and sometimes in different regions within countries – even though they may have the same DNA. This challenge has recently been reduced greatly, however, thanks to new DNA research. In particular, the new and already well-known Robinson/Harding/Vouillamoz 2012 book called *Wine Grapes* provides a detailed guide to nearly 1400 commercially grown 'prime' varieties – and it also identifies their various synonyms. The 'prime' name is chosen by those authors according to the name used in its country or region of origin. In addition, the Julius Kühn-Institut for Grapevine Breeding at the Federal Research Centre for Cultivated Plants in Geilweilerhof, Germany is maintaining/building a *Vitis International Variety Catalogue* ([www.vivc.de](http://www.vivc.de)) that provides additional DNA-based varietal information.

With that now-far-greater capacity to avoid spuriously indicating diversity of winegrape varieties across regions and countries, and with the European Union recently publishing census data on bearing area by variety and region circa 2010 for most of its winegrape-producing member countries, the time is right to bring together for the first time a global compendium of data on bearing area by variety and region (and hence also by country). This can be treated as a supplement to *Wine Grapes* and *The World Atlas of Wine* (or similar atlases) for readers seeking an idea of the relative importance of the world's wine regions and varieties at least as reflected in winegrape bearing area data circa 2010 and 2000 (and, in more limited form, 1990).

Assembling those data has been a time-consuming task, but it would have taken much longer (and in some cases been impossible) without the generous assistance of a large number of people in numerous countries. First and foremost, grateful thanks go to Jancis Robinson MW, Julia Harding MW and José Vouillamoz for promptly responding to endless emailed questions and for sharing their vast knowledge by reacting to drafts of numerous tables and charts, as well as for providing data for such countries as China, Japan, Russia and Ukraine.

We are also grateful to Patrick Fegan of the Chicago Wine School, whose 2003 book *The Vineyard Handbook: Appellations, Maps and Statistics* helped with its 1990 varietal data (see Table 3) and also circa 2000 data for several small wine-producing countries, for which we otherwise would have had only circa 2010 information.

At the risk of accidentally omitting some names (for which we humbly apologize in advance), our sincere thanks for providing or leading us to the following national data go to, in author alphabetical order, Julian Alston, Kate Fuller and Sandro Steinbach (California and Washington States, USA), Georgi Apkhazava (Georgia), Peter Bailey, Sheralee Davies, Alan Nankivell and Mark Rowley (Australia), Stefan Bojnec (Croatia, Serbia and Slovenia), Bruce Bordelon (Indianan, USA), Jasna Čačić (Croatia), Mark Chien (Pennsylvania, USA), Donald Cyr (Canada), Dominique Desbois (for carefully assembling French survey data for 2009, pending the publication of the official census data which have yet to be released), Christy Eckstein (Ohio, USA), Denis Gustin (Thailand), Anatassios Haniotis and Kargarita Koumanioti (for advance access to the 2009 Greek census data), Giulia Meloni (EUROSTAT data plus Brazil, Italy, Peru), Javier Merino and Jimena Estrella (Argentina), Taner Öğütoğlu (Turkey), Sergey Oleichenko, Dauren Oshakbaev and Alfinura Sharafeyeva (Kazakhstan), Bruce Reisch (New York State, USA), Jorge Tenotio (Mexico), Gabriel Tinguely (Switzerland), Áron Török (for advance access to the 2010 Hungarian census data), Angeliki Tsiolo of the OIV (for contacts in various countries), and last but definitely not least, the trio of Annalisa Zezza, Roberta Sardone and Eugenio Pomarici (for advance access to and heroic efforts to polish the 2010 Italian census data).

We acknowledge and thank Australia's Grape and Wine Research and Development Corporation for assisting with funding the research project that produced this data collection. We are grateful also to Lachlan Deer and Claire Hollweg for earlier research assistance with circa 2000 winegrape varietal data compilation for a dozen key countries that provided a prototype for the present much more comprehensive study (see Anderson, K., "Varietal Intensities and Similarities of the World's Wine Regions", *Journal of Wine Economics* 5(2): 270-309, Winter 2010).

While we have made every effort to ensure the accuracy and currency of information within this compendium, we cannot accept responsibility for information which may later prove to be misrepresented or inaccurate, or for any reliance placed on the information by readers. We warmly welcome comments on the raw data and the indicators derived from them, and we would gratefully receive any new databases for omitted countries or updated, expanded or revised databases for those countries already included.

## Statistical sources

The most important source of winegrape bearing area data for this compendium is EUROSTAT, because it provides data by region for the European Union's member countries for the two most-recent decadal censuses, which were circa 2000 and 2010. They can be found at [http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search\\_database](http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database) [In the Data Navigation Tree, click on "Agriculture, forestry and fisheries" then "Agriculture" then "Structure of orchards and vineyards" then "Vineyard" and then "Basic vineyard survey".] Since that source provides data for a large share of the world's winegrape production, those years are the ones targeted for all other countries. For the majority of the EU countries the census dates were a year earlier, so 1999 and 2009 were the vintages targeted for other Northern Hemisphere countries while 2000 and 2010 were targeted for Southern Hemisphere countries (bearing in mind that harvesting is late in the calendar year in the north and early in the calendar year in the south).

Not all EU-27 countries have their latest census data uploaded on that EUROSTAT website yet, so we approached government officials in the missing member countries (France, Greece, Hungary, Italy) to secure advance copies of the circa 2010 data that have yet to be uploaded even in those countries. In the case of France, its less-detailed 2009 annual survey rather than the decadal census data had to be used for the latest numbers, but at least France's detailed census data are available at EUROSTAT for 1999.

The national and regional data sources, and the exact years to which they relate, are listed in Table A of this section.

The choice of countries to include was determined by national shares of global wine production. The 44 countries for which data are available for circa 2010 account for 99% of global grapewine output in 2010. The only other country producing more than 0.1% of the world's wine is Macedonia (0.3%), for which we were unable to locate data. Of those 44 countries, we were unable to secure reliable data for 2000 for 9 of them (China, Japan, Kazakhstan, Mexico, Myanmar, Peru, Thailand, Turkey, and Ukraine). The combined share of global wine production of those 9 countries in 2000 was only 1.6% (compared with 5.1% in 2010), but to retain their unusual varietal contributions we included them as a group (called "Missing 9 in 2000") by assuming each of them had (i) the same varietal distribution then as in 2010 and (ii) a national acreage that was the same fraction of its 2010 acreage as was its national wine production volume.

In addition to national data, bearing area data by variety are available for regions within 29 of our 44 countries in 2010, and for 14 of those countries in 2000. In aggregate there are 521 unique regions represented in 2010 and 414 in 2000.

As for winegrape varieties, our key source for identifying DNA-identical varieties is the Robinson/Harding/Vouillamoz 2012 book called *Wine Grapes* (hereafter RHV). It provides a detailed guide to 1368 commercially grown 'prime' varieties, and it also identifies their various synonyms used in various countries. Those authors chose the 'prime' name according to the name used in its country or region of origin. In addition, the *Vitis International Variety Catalogue* ([www.vivc.de](http://www.vivc.de)) provides additional DNA-based varietal information. The RHV book's prime varieties account for 93% of the global winegrape area

in 2010 and 86% in 2000, VIVC accounts for 2%, and the rest were listed in neither of those sources. We also adopt RHV's berry colours, although we simplify their five categories to just three: the darkest two we call red, the lightest two we call white, and the middle grey colour we call 'non-red/white' (which accounts for just 2.1% of the global area in 2010, of which almost half is Pinot Gris/Grigio, and 1.3% in 2000).<sup>1</sup>

There are two exceptions to our use of RHV prime names. One concerns Pinot, which is thought to have existed for two millennia and which therefore has many clones. Until recently the most popular clones – which include all three of our colour categories – were thought to be distinct varieties, and have been marketed separately to different niches in the market. For that reason we retain separately the following five, each of which has several synonyms identified by RHV: Pinot Blanc, Pinot Gris, Pinot Meunier, Pinot Noir, and Pinot Noir Précoce. The other exception is Garnacha, which also has both red and white mutations. In that case we retain separately the following four, each of which has several synonyms identified by RHV: Garnacha Blanca, Garnacha Peluda, Garnacha Roja, and Garnacha Tinta.

Apart from the bearing area data, various other variables are included in some of the tables. Their sources are as follows:

Tables 2 and 3: FAOSTAT data for total grapevine area, total grape production, grape yield per hectare, and agricultural land (arable land and land used for permanent crops) (<http://faostat.fao.org>).

Table 4: Varietal bearing area data for 1990 are from Fegan, P.W. (2003), *The Vineyard Handbook: Appellations, Maps and Statistics*, revised edition, Springfield IL: Phillips Brothers. We estimate the global winegrape bearing area in 1990 based on total and winegrape production data and taking into account that the global winegrape yield per hectare averages 15% less than the total grape yield, based on data in Anderson, K. and D. Norman, *Global Wine Production, Consumption and Trade, 1961 to 2001: A Statistical Compendium*, Adelaide: Centre for International Economic Studies, 2003.

In some tables we also provide aggregate data for the Old World and the New World sets of countries. For that purpose we define the Old World as all of continental Europe (not including the United Kingdom but including Cyprus, Lebanon, Turkey and all the countries that were part of the former Yugoslavia or Soviet Union). All other countries are considered here as the New World (including therefore, if somewhat unusually, the Asian winegrape-growing countries for which we have data, which are China, Japan, Myanmar and Thailand).

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<sup>1</sup> Numerous countries have an 'other varieties' category for each region, only some of which sub-divide that category according to berry colour. When no sub-division is provided, we assume the proportions of 'other varieties' that are red and white are the same as the proportions in the named varieties for that region.

Table A: Sources of national winegrape bearing area data<sup>a</sup>

<i>Country</i>	<i>Actual years</i>	<i>Data sources (latest, then earlier date)</i>
Algeria	2001	Fegan (2003); and assumed unchanged for 2010
Argentina	2000, 2011	<a href="http://www.aredelvino.com">www.aredelvino.com</a> ; provides more-detailed data in 2011 than 2010
Armenia	2001	Fegan (2003); and assumed unchanged for 2010
Australia	2001, 2010	<a href="http://www.wineaustralia.com">http://www.wineaustralia.com</a> ; more-detailed series begins in 2001
Austria	1999, 2009	EUROSTAT
Brazil	2000, 2010	<a href="http://vitiBrasil.cnpqv.embrapa.br/index.php?opcao=opt_03">http://vitiBrasil.cnpqv.embrapa.br/index.php?opcao=opt_03</a> , and Fegan (2003)
Bulgaria	2001, 2009	EUROSTAT, and Fegan (2003)
Canada	2001, 2009	<a href="http://www.grapegrowersofontario.com/sites/default/files/2012%20annual%20report.pdf">www.grapegrowersofontario.com/sites/default/files/2012%20annual%20report.pdf</a> , and Fegan (2003); British Columbia data are 2011 not 2009, from <a href="http://www.winebc.com">www.winebc.com</a>
Chile	2000, 2009	<a href="http://www.odepa.gob.cl/odepaweb/servicios-informacion/publica/catastro-vides-2009.pdf">www.odepa.gob.cl/odepaweb/servicios-informacion/publica/catastro-vides-2009.pdf</a>
China	2009	<i>China Agricultural Yearbook 2010</i> , via Julia Harding, personal communication
Croatia	2001, 2011	Croatian Ministry of Agriculture, and Fegan (2003)
Cyprus	2000, 2009	EUROSTAT, and Fegan (2003)
Czech Rep	2001, 2009	EUROSTAT, and Fegan (2003)
France	1999, 2009	Personal communication with Dominique Desbois, and EUROSTAT
Georgia	2004	Georgian Wine Association; assumed unchanged for 2000 and small growth by 2009
Germany	1999, 2009	EUROSTAT
Greece	1999, 2009	Hellenic Statistical Authority, and EUROSTAT
Hungary	2000, 2010	Hungarian Ministry of Agriculture, and Fegan (2003)
Italy	2000, 2010	Italian Ministry of Agriculture, and EUROSTAT
Japan	2009	Julia Harding, personal communication
Kazakhstan	2007	Dauren Oshakbaev, personal communication; assumed unchanged for 2010
Luxembourg	1999, 2009	EUROSTAT
Mexico	2011	Mexican Ministry of Agriculture, <a href="http://www.siap.gob.mx">www.siap.gob.mx</a>
Moldova	2009	Moldovan Ministry of Agriculture, via Julia Harding, personal communication
Morocco	1999	<a href="http://agriculture.ovh.org">http://agriculture.ovh.org</a> ; and assumed almost unchanged for 2010
Myanmar	2012	<a href="http://redmountain-estate.com/varieties.html">http://redmountain-estate.com/varieties.html</a>
New Zealand	2000, 2009	<a href="http://wineinf.nzwine.com/statistics_outputs.asp?id=89&amp;cid=6&amp;type=n">http://wineinf.nzwine.com/statistics_outputs.asp?id=89&amp;cid=6&amp;type=n</a> ; survey not conducted in 2010
Peru	2008	<a href="http://www.minag.gob.pe/portal/download/pdf/herramientas/boletines/DocumentoFinalVid.pdf">www.minag.gob.pe/portal/download/pdf/herramientas/boletines/DocumentoFinalVid.pdf</a>
Portugal	1999, 2009	EUROSTAT
Romania	2001, 2009	EUROSTAT, and Fegan (2003)
Russia	2000, 2009	Julia Harding, personal communication, and Fegan (2003)
Serbia	2001	Fegan (2003); and assumed unchanged for 2010
Slovakia	2000, 2009	EUROSTAT, and Fegan (2003)
Slovenia	2000, 2009	EUROSTAT, and Fegan (2003)
South Africa	2002, 2011	<a href="http://www.wosa.co.za/sa/stats_sawis_annual.php">http://www.wosa.co.za/sa/stats_sawis_annual.php</a>
Spain	1999, 2009	EUROSTAT
Switzerland	1999, 2009	<a href="http://www.blw.admin.ch/themen/00013/00084/00344/index.html?lang=de">http://www.blw.admin.ch/themen/00013/00084/00344/index.html?lang=de</a>
Thailand	2010	Thailand Grape Vine Survey, from Denis Gastin, personal communication
Tunisia	2000	Fegan (2003); and assumed unchanged for 2010
Turkey	2010	Taner Ögütoğlu of Wines of Turkey, personal communication
Ukraine	2009	Ukrainian Ministry of Agriculture via Julia Harding, personal communication
UK	1999, 2009	EUROSTAT
United States <sup>b</sup>	1999, 2009	<a href="http://www.nass.usda.gov">www.nass.usda.gov</a>
Uruguay	2000, 2012	<a href="http://www.inavi.com.uy/categoria/38-estada-sticas-de-via-edos.html">http://www.inavi.com.uy/categoria/38-estada-sticas-de-via-edos.html</a> , and Robinson, J. <i>The Oxford Companion to Wine</i> , 3 <sup>rd</sup> edition, 2006, p. 723

Table A (continued): Sources of national winegrape bearing area data<sup>a</sup>

<sup>a</sup> EUROSTAT data are available at [http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search\\_database](http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database). In addition, some data for 1990 are provided from Fegan, P.W. (2003), *The Vineyard Handbook: Appellations, Maps and Statistics*, revised edition, Springfield IL: Phillips Brothers, for the Chicago Wine School.

<sup>b</sup> Dates for the various US states vary according to availability, shown below, with additional sources as follows:  
[www.oda.state.or.us/oass/oass.html](http://www.oda.state.or.us/oass/oass.html)

<http://gwi.missouri.edu/publications/mo-winery-impact.pdf>

[www.virginiawine.org/system/datas/320/original/2010 Commercial Grape Report.pdf?1312838511](http://www.virginiawine.org/system/datas/320/original/2010_Commercial_Grape_Report.pdf?1312838511)

[www.nass.usda.gov/Statistics\\_by\\_State/Illinois/Publications/Special Surveys/12Grape Wine Final Publication.pdf](http://www.nass.usda.gov/Statistics_by_State/Illinois/Publications/Special_Surveys/12Grape_Wine_Final_Publication.pdf)

Arizona-2008, Arkansas-2009, California-1991, 1999 and 2009, Colorado-2009, Georgia-2009, Illinois-2011, Indiana-2011, Iowa-2006, Kentucky-2010, Michigan-2002 and 2011, Minnesota-2007, Missouri-2010, New York-1990, 2001 and 2011, North-Carolina-2009, Ohio-2008, Oregon-1990, 2000 and 2010, Pennsylvania-2008, Texas-2010, Virginia-2008, Washington-1990, 1999 and 2011



## Technical notes

This section provides definitions of the units used in, and the various indicators generated from, the raw data in this compendium.

### *Definitions of unit measures*

<i>Variable</i>	<i>Unit (per year)</i>
Grape vine bearing area	'000ha
Volume of grape production	kt
Grape yield	t/ha
Volume of wine production	ML
Volume of wine consumption	ML
Volume of wine exports and imports	ML
Value of wine exports and imports	current \$USm
Unit value of wine exports and imports	current \$US/L

### *Explanations of unit measures*

<i>Abbreviation</i>	<i>Definition</i>	<i>Conversion</i>
ha	hectare	10,000 square metres or 2.471 acres
t	tonne	1,000 kilograms or 2,205 pounds
kt	kilotonne	1,000 tonnes
L	litre	1,000 millilitres or 0.2642 US gallons
ML	megalitre	1 million litres

### *Definition of Varietal Intensity Index*

A Varietal Intensity Index is defined as a variety's share of a region's winegrape area divided by that variety's share of the global winegrape bearing area. The Varietal Intensity Index is thus a complement to share information in that it indicates the importance of a variety in a region not relative to other varieties in that region but rather relative to that variety in the world.

Specifically, define  $f_{im}$  as the proportion of bearing area of grape variety  $m$  in the total winegrape bearing area in region or country  $i$  such that the proportions fall between zero and one and sum to one (i.e., there is a total of  $M$  different grape varieties across the world, and  $0 \leq f_{im} \leq 1$  and  $\sum_m f_{im} = 1$ ). For the world as a whole,  $f_m$  is the bearing area of grape variety  $m$  as a proportion of the total global winegrape area, and  $0 \leq f_m \leq 1$  and  $\sum_m f_m = 1$ . Then the Varietal Intensity Index,  $V_{im}$  for variety  $m$  in region  $i$ , is:

$$(1) \quad V_{im} = f_{im}/f_m$$

### ***Definition of Index of Varietal Similarity***

An Index of Varietal Similarity has been defined by Anderson (2010) to measure the extent to which the varietal mix of one region or country matches that of another region or country or the world. It can also be used to compare the varietal mix of a region or country over time. In defining the index, Anderson (2010) borrows and adapts an approach introduced by Jaffe (1986) and Griliches (1979). That approach has been used subsequently by Jaffe (1989), and by others including Alston, Norton and Pardey (1998) and Alston et al. (2010, Ch. 4), to measure inter-firm or inter-industry or inter-regional technology spillover potential.<sup>2</sup>

The mix of grape varieties is a form of revealed preference or judgement by vignerons about what is best to grow in their region. That judgement is affected by not only terroir but also past and present economic considerations, including current expectations about future price trends plus the sunk cost that would be involved in grafting new varieties onto existing rootstocks or grubbing out and replacing existing varieties.

The vector of grape varietal shares defined above,  $f_i = (f_{i1}, \dots, f_{iM})$ , locates region  $i$  in  $M$ -dimensional space. Noting that proximity is defined by the direction in which the  $f$ -vectors are pointing, but not necessarily their length, Jaffe (1989) proposes a measure called the angular separation of the vectors which is equal to the cosine of the angle between them. If there were just two varieties,  $m$  and  $n$ , and region  $i$  had 80 percent of its total vine area planted to variety  $m$  whereas only 40 percent of region  $j$  was planted to variety  $m$ , then their index of regional similarity is the cosine of the arrowed angle between the two vectors. When there are  $M$  varieties, this measure is defined as:

$$(2) \quad \omega_{ij} = \frac{\sum_{m=1}^M f_{im} f_{jm}}{\left( \sum_{m=1}^M f_{im}^2 \right)^{1/2} \left( \sum_{m=1}^M f_{jm}^2 \right)^{1/2}},$$

where again  $f_{im}$  is the area of plantings of grape variety  $m$  as a proportion of the total grape plantings in region  $i$  such that these proportions fall between zero and one and sum to one (i.e., there is a total of  $M$  different grape varieties across the world, and  $0 \leq f_{im} \leq 1$  and  $\sum_m f_{im} = 1$ ). This makes it possible to indicate the degree of varietal mix “similarity” of any pair of regions. The index also can be generated for each region relative to the average of the world’s  $N$  regions, call it  $\omega$ . In short,  $\omega_{ij}$  measures the degree of overlap of  $f_i$  and  $f_j$ . The numerator of equation (2) will be large when  $i$ ’s and  $j$ ’s varietal mixes are very similar. The denominator normalizes the measure to be unity when  $f_i$  and  $f_j$  are identical. Hence,  $\omega_{ij}$  will be zero for pairs of regions with no overlap in their grape varietal mix, and one for pairs of regions with

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<sup>2</sup> Alston, J.M., Andersen, M.A., James, J.S. and Pardey, P.G. (2010), *Persistence Pays: U.S. Agricultural Productivity Growth and the Benefits from Public R&D Spending*, New York: Springer.

Alston, J.M., Norton, G.W. and Pardey, P. (1998), *Science under Scarcity: Principles and Practice for Agricultural Research Evaluation and Priority Setting*, London: CAB International.

Anderson, K. (2010), ‘Varietal intensities and similarities of the world’s wine regions’, *Journal of Wine Economics* 5(2): 270-309, Winter.

Griliches, Z. (1979), ‘Issues in assessing the contribution of R&D to productivity growth’, *Bell Journal of Economics* 10: 92-116.

Jaffe, A.B. (1986), ‘Technological opportunity and spillovers of R&D: evidence from firms’ patents profits and market value’, *American Economic Review* 76(5): 984-1001,

Jaffe, A.B. (1989), ‘Real effects of academic research’, *American Economic Review* 79(5): 957-70.

an identical varietal mix. For cases in between those two extremes,  $0 < \omega_{ij} < 1$ . It is conceptually similar to a correlation coefficient. Like a correlation coefficient, it is completely symmetric in that  $\omega_{ij} = \omega_{ji}$  and  $\omega_{ii} = 1$ . Thus the results can be summarized in a symmetric matrix with values of 1 on the diagonal, plus a vector that reports the index for each region relative to the global varietal mix.



# A guide to where in the world various winegrape varieties are grown

The dramatic globalization of the world's wine markets over the past two or three decades (see Anderson 2004) has generated countless new wine consumers. This has added to both the opportunities and competitive challenges for producers seeking to differentiate their product to attract the attention of consumers. Consumers in turn are always looking for new types of wines, and more so as wines within at least the lower-priced product ranges become more homogeneous with multinationalization of both wineries and wine retailers.

One strategy for producers has been to display grape varietal names on wine bottle labels. Its success, especially for lower-priced New World wines, has led to demands in the European Union for freeing up labelling laws so as to allow such labelling there also. Meanwhile, producers in the New World are increasingly realizing the marketing value of going beyond country of origin to regional (and even single-vineyard) labelling as another form of product differentiation – something that has long been practiced by Europe's traditional producers.

In addition to striving to differentiate their product, producers are also well aware of the impact climate changes (higher temperatures, more extreme weather events) are having on their winegrapes. Adaptation strategies include switching to warmer-climate or more-resilient grape varieties, and re-locating to a higher latitude or altitude to retain the current mix of grape varieties. Especially in the New World, where regions are still trying to identify their varietal comparative advantages and where regulations do not restrict varietal choice, winegrowers are continually on the lookout for attractive alternative varieties that do well in climates similar to what they expect theirs to become in the decades ahead. Moreover, the biotechnology revolution is providing breeders with new opportunities, which is increasing the interest in exploring traits of little-known varieties.

These marketing and climate adaptation needs are generating a rapidly growing demand for information on which winegrape varieties are grown in the world's various wine regions. Since 1971 *The World Atlas of Wine* has provided a great deal of information about where winegrapes are grown (the 7<sup>th</sup> Edition is by Johnson and Robinson 2013). That has been complemented by the new book called *Wine Grapes*, by Robinson, Harding and Vouillamoz (2012), which provides a detailed guide to 1368 commercially grown 'prime' varieties – and to their various synonyms, based on the latest DNA research. (The authors chose each 'prime' name according to the name used in its country or region of origin.) Neither of those seminal books, nor any other wine atlas or wine encyclopaedia, provides comprehensive global data on the bearing areas of winegrapes by region and variety. This is not surprising because, to our knowledge, no such global compendium of data has been readily available before now.<sup>3</sup>

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<sup>3</sup> The handbook by Fegan (2003) provides information circa 2000 on key regions in the main wine-producing countries, and on the key varieties in those countries, but it does not provide a matrix of variety by region data. A preliminary matrix is provided for circa 2000 by Anderson (2010), but it covers just 166 regions and 258 varieties in a dozen countries – and many of those 258 varieties are not unique, because that study did not re-name the synonyms of primes.

Another reason for compiling a comprehensive global matrix of winegrape bearing areas by variety and region is because concern has been expressed that the diversity of winegrapes is narrowing to a few ‘international’ varieties. Johnson and Robinson (2013, page 8) note that vignerons are at last beginning to respond by reverting to neglected local varieties in the Old World and by exploring alternatives to the main ‘international’ varieties in the New World. But how severe is the current concentration compared with earlier times; and how different is the concentration in the Old World compared with the New World? Answering that question requires first re-naming synonyms by their prime, to avoid understating the degree of concentration.<sup>4</sup> That task is now possible, thanks to the book by Robinson, Harding and Vouillamoz (2012),<sup>5</sup> which in turn has been made possible by the DNA profiling of recent years that has added hugely to traditional ampelography (identification based on physical characteristics of the vine’s appearance).<sup>6</sup>

With the above concerns in mind, this volume draws on a newly compiled global database (Anderson and Aryal 2013) to estimate numerous indicators that capture changes over the first decade of this century in the varietal mix of the world’s wine regions. It builds directly on an earlier study that examined data for circa 2000 for just 12 countries (Anderson 2010). That paper defined two helpful indicators: a varietal intensity index, which captures the degree of each region’s specialization in certain varieties; and a varietal-based regional similarity index, which captures the degree of similarity of each region’s varietal mix with that of any other region (or of the nation or world). Those and several other indicators are used in the present study too.

Apart from adding an extra year’s data, the present volume significantly advances the Anderson (2010) study in several ways: it has 32 additional countries so that the sample now covers all but 1% of global wine production; it is far more detailed in terms of having 521 regions and 2019 varieties (of which 1271 are ‘primes’ and 748 are their synonyms) compared with only 166 regions and 258 varieties previously; and it has removed spurious differences in varietal mixes resulting from different varietal names being used for what have been shown since to be DNA-identical varieties.

The years chosen correspond to the agricultural census periods of the European Union, which were 1999 or 2000 and 2009 or 2010. For the non-EU countries data have been sought for the earlier year in the Northern Hemisphere and the latter year in the Southern Hemisphere, so they refer to vintages that were less than 6 months apart. Inevitably not all

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<sup>4</sup> Some varieties are not as rare as previously believed. For example, Zinfandel is genetically identical not only to Pimitivo (in Puglia) but also to Tribidrag (in Croatia). Also identical are the two ‘varieties’ in Italy’s Liguria region, near Genoa, of Pigato and Vermentino – which are also genetically identical to Favorita (in Italy’s Piedmont) and Rolle (in southern France). Their prime name, according to Robinson et al. is Vermentino.

<sup>5</sup> The Vitis listing compiled by JKI (2013) for European countries provided a few more primes. There is also a list of varieties maintained by the OIV (2012), but because OIV is an inter-governmental organization it uses only the names adopted by each member country.

<sup>6</sup> Scientific publications from that vine profiling began in South Australia in 1993 and in California at UC Davis in 1997, and have surged ahead since then. When one parent is missing, it is still possible for DNA profiling to identify parent-offspring relationships. And even when both parents are unknown, a probabilistic approach can be used to detect siblings, grandparents or grandchildren. The latter has been done for Syrah, for example: its parents were discovered barely a decade ago to be Mondeuse Blanche and Dureza, its great grandparent is very likely Pinot (according to Vouillamoz and Grando 2006), and it is either a grandchild or a half-sibling of both Mondeuse Noire and Viognier. Undoubtedly further DNA profiling will reduce this uncertainty and add to our stock of knowledge of these and the other 10,000 or so grape varieties currently available globally.

countries or regions had data for exactly those vintages, but those exceptions account for a very small fraction of the data.

The database on which this volume draws thus involves two years (2000 and 2010, plus some 1990 data) by up to 521 regions (in 44 countries), by up to 1271 varieties. Such a large three-dimensional database of 1.3 billion cells (many of which are zeros) is difficult to digest as large spreadsheets, hence the present volume which summarizes the data in numerous ways including though calculating various shares and indexes.

This Introduction provides a guide to the summary charts and tables, and is structured as follow. The next section describes the coverage of the database in more detail. The following two sections discuss the two key empirical indicators that are derived from the share data: a varietal intensity index to highlight the varietal specialization of each region or country; and a varietal similarity index to distinguish between regions and countries according to their overall mix of varieties. Select findings from the report's many tables are then provided, with the help of charts that provide visual images of key features of various tables. The final section draws out some implications and discusses other prospective uses of the database.

### **Coverage of countries and varieties**

Data on bearing area of winegrapes are available by variety and region for most key wine-producing countries. In the case of the European Union countries, plantings are available from one source (Eurostat 2013), while for other countries they are typically available online from a national wine industry body or the national statistical agency. The United States and Canada are key exceptions, where data are collected at the state/provincial level and only for those with significant wine production. The raw data have been compiled, and varietal synonyms have been changed to prime varietal names, by Anderson and Aryal (2013).

Table 1 lists the 44 countries included in the dataset and shows the number of regions and prime varieties in each country in 2000 and 2010. The relative importance of those countries in global winegrape area and global wine production is reported in Table 2 (which also shows the other countries reported to be producing wine, although collectively they account for just 1% of global wine output). A more-extensive set of key indicators of grape production over the past two decades is provided in Table 3.

The data in Tables 2 and 3 are three-year averages based around the year shown, that is, they refer to 1989-91, 1999-2001 and 2009-11, so as to reduce seasonal variation. Of the 44 countries included, reliable area data for 2000 were unavailable for nine of them (China, Japan, Kazakhstan, Mexico, Myanmar, Peru, Thailand, Turkey, and Ukraine). The combined share of global wine production of those nine countries in 2000 was only 1.6% (compared with 5.1% in 2010), but their varietal contributions are included as a group (called "Missing 9 in 2000") by assuming each of them had (i) the same varietal distribution in 2000 as in 2010 and (ii) a national area that was the same fraction of its 2010 area then as was its national wine production volume. As for 1990, the data refer only to countries (no regional detail) and only to the world's most important 50 or so varieties.

The **vast differences between countries in their winegrape bearing areas** are depicted in Chart 1. The biggest three, Spain, France and Italy, account for 54% of the

world's winegrape vineyard area in both 2000 and 2010. The next biggest is the United States, but its share is less than 5%.

The same four countries dominate global wine production volume and value<sup>7</sup> (accounting for 60% in aggregate). However, the 2010 rankings among them in wine production differ considerably from that in winegrape area: France and Italy are ahead of Spain in wine production volume, and France and the United States are well ahead of Italy and Spain in terms of pre-tax value of wine production, followed by Germany and Australia (Chart 2). One reason for these differing rankings is that the huge La Mancha region of Spain has bush vines sparsely planted to the drought-resistant but low-quality Airén variety, much of whose grapes are used to produce brandy rather than wine.

When expressed as cumulative shares by the 30 largest producing countries, it is evident from Chart 3 that the **differences between countries are greater in global wine production volume than they are in winegrape area.**

The globalization of the world's wine markets has meant that the curve linking the cumulative shares of global wine production by the 30 largest producing countries has been falling substantially (Chart 4). That is, **with the industry's globalization, the national concentration of the world's vineyards has been gradually diminishing over the past century.**

**The global area of winegrapes has declined by almost 6% over the first decade of this millennium** (Table 4). This is despite increases of around 30% in the United States and Georgia, 40% in the Czech Republic, and 220% in New Zealand. The biggest falls were in Spain (13%), Portugal (20%) and several countries in southeastern Europe (Chart 5). That overall decline continues an earlier trend: **the global area fell 8% in the final decade of the 20<sup>th</sup> century** (last row of Table 6).

These changes in bearing area are also reflected in changes in the winegrape intensity of cropland usage. Chart 6 reveals a **huge variance across countries in the shares of national cropland under winegrapes.** It ranges from 6-13% in the six countries where this indicator is highest (Portugal, Chile, Italy, Georgia, Moldova and Spain) to less than 0.2% in Australia, China and the United States.

Drilling down from total winegrape area to the area under different varieties, Table 5 lists alphabetically all the prime varieties in the dataset in 1990, 2000 and 2010, while Table 6 ranks all but the smallest of them according to their 2010 shares of global area. The data for 1990 are limited to little more than 50 varieties, but they cover three-quarters of that year's global winegrape area (last page of Table 6). The varieties with less than 100 ha globally are included in Table 6 only if there are data for both 2000 and 2010, as the right-hand half of Table 6 is devoted to reporting the decadal changes (in both hectares and as a percentage) in individual varieties' global bearing area.

**The extent of varietal concentration in the world's vineyard has increased non-trivially over the decade to 2010.** This is a reversal of the trend of the previous decade (Chart 7). Half the world's plantings were accounted for by 21 varieties in 2000 but, by 2010, that total had dropped to 15 varieties. This **varietal concentration is more apparent in New**

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<sup>7</sup> The value data are estimated for 2009 by Anderson and Nelgen (2011, Table 175).



**World countries**, where the top seven varieties accounted for over half of all plantings in 2010, whereas 16 varieties were needed in the Old World to get to the half-way point (Chart 8).

Those changes in varietal concentration in the world's vineyard are reflected in the **marked changes in the global rankings of varieties over the period since 1990** (Tables 5 and 6). Cabernet Sauvignon and Merlot have more than doubled their shares to take them from 8<sup>th</sup> and 7<sup>th</sup> to 1<sup>st</sup> and 2<sup>nd</sup> places, and Tempranillo and Chardonnay have more than trebled their shares to take 4<sup>th</sup> and 5<sup>th</sup> places, while Syrah has jumped from 35<sup>th</sup> to 6<sup>th</sup>. Sauvignon Blanc and Pinot Noir are the other two to move into the top ten. These have all been at the expense of Airén which has fallen from 1<sup>st</sup> to 3<sup>rd</sup>, Garnacha from 2<sup>nd</sup> to 7<sup>th</sup>, and Trebbiano from 5<sup>th</sup> to 9<sup>th</sup>. The fastest-growing and fastest-contracting varieties are depicted in Charts 9 and 10.

These changes ensure that the chart of the world's top 35 varieties as ranked in 1990 shows a quite different mix and rank ordering to the comparable chart for 2010 (Charts 11 and 12). The decline in varietal concentration in the world's vineyard in the 1990s was due to the large fall in the importance of the six most-common winegrape varieties in 1990 (especially low-quality Airén and Sultaniye) and the beginning of the rise in importance of Merlot, Cabernet Sauvignon, Chardonnay and Syrah as regions sought to improve the quality of their winegrapes. Even in just the decade to 2010 there have been considerable changes in the relative importance globally of the top 30 red and top 30 white varieties (Charts 13 and 14).

These changes have meant that the overall **share of red varieties in the global winegrape area has risen considerably: from 49% to 55% in the decade to 2010** (Chart 15). That share varies hugely across countries though, from 96% in China and even higher in North Africa to just 12% in Georgia and 8% in Luxembourg (Chart 16 and Tables 7 and 8). And it has changed far more in some countries than in others, whether looked at in terms of red's share of the national total or in national hectares. Of the countries that have increased the share of red varieties in their national mix, the majority are in the Old World (Chart 17). In actual area, the largest rises in red's share are in Spain, the United States and Italy while the largest falls are in Romania, Bulgaria and France (Chart 18).

Within the red and white winegrape categories, the cumulative share curves in Chart 19 indicate that the **varietal concentration has increased almost equally for red and white winegrapes over the 2000 to 2010 period**.

The availability of area data by region within each country varies considerably across countries, and is not identical in the two periods (Tables 9 and 10). The available data for France has more regions in 2010 than in 2000 while the opposite is true of Italy, for example. For the United States the greatest regional detail is of course for California, where 80-90% of the winegrapes are grown, but there was also regional detail within New York State and Oregon by 2000 and also for what is now the state with the second-largest winegrape area, Washington, by 2010 (Table 11). Australia has an unusually large number of regions because data began to be collected by Geographical Indication following the introduction of that GI legal institutional arrangement in the 1990s (Table 12). In 2010, there are just 12 of our 44 countries for which no regional breakdown is available, and most of them are small wine producers.

The colour, synonyms and country of origin of each of the alphabetically listed 1271 prime winegrape varieties are shown in Table 13, along with their 2010 global area, share, and rank. The relative importance of each of the synonyms of each prime variety is indicated in Tables 14 and 15 for 2000 and 2010, respectively. One of the more-extreme cases is Cot, better known by the synonym Malbec which accounted for 74% of Cot's global area in 2000 and 84% in 2010. To make for easy reference, Tables 16 and 17 show those same data but with the synonyms listed alphabetically. Included in those tables are the names of those primes that have synonyms. As the last page of those tables show, **a little over one-quarter of the global winegrape area is devoted to varieties that are known locally by their synonyms rather than their prime**; and just under one-quarter is planted to primes that have no synonym.

Mention has been made earlier of the concern that the diversity of winegrapes has been narrowing to a few 'international' varieties. Certainly there are very few winegrape varieties that are not from the *Vitis vinifera* species.<sup>8</sup> They account for just under 1.5% of the total global area in our database in 2010 (and 1.3% in 2000), of which more than half are in Brazil and one-sixth are in each of Moldova and the United States.

One way to explore the diversity issue is to examine what share of the global area is devoted to varieties by their country of origin. **Between 2000 and 2010 the global winegrape share devoted to French varieties rose from 26% to 36%** (Table 18), which contrasts with France's own shares of the global bearing area and wine production which were just 18% in 2000 and 21% in 2010 (Table 2). **The next most important country of origin is Spain, accounting for 26% of the world's area in 2010, down from 28% in 2000**, which is just a little above Spain's own share of the global bearing area of 22-24%. **Third is Italy**, whose country of origin share is almost the same as Italy's share of global area of 13% -- **but in terms of number of varieties, Italy's global winegrape share is more than three times that of Spain**. No other country can lay claim to being the origin of more than 3% of the world's winegrape varieties in terms of bearing area. However, in terms of number of varieties Portugal appears to have a large share, but that is because it has introduced a particularly detailed reporting system that by 2010 captured many of its varieties that are planted to a small fraction of 1% of its total plantings. That is revealed in Tables 19 and 20, which list alphabetically the prime varieties from each country of origin and their global area and share.<sup>9</sup> Where those various varieties are planted is shown in the columns of Tables 21 and 22 for each of our 44 countries, as well as for the Old World and the New World aggregates. **Particularly striking is the high and increasing dominance of winegrapes of French origin in the New World's vineyards: that share averaged 67% in 2010, up from 53% in 2000. It compares with an increase from 20% to 27% for the Old World's vineyards.** The shares of French, Spanish and Italian winegrape varieties in various countries' vineyards are shown in Charts 20 to 22, respectively.

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<sup>8</sup> A total of just 22 varieties have been identified as not *Vitis vinifera*: Baco Blanc, Bailey, Bordo, Campbell Early, Catawba, Concord, Couderc, Couderc Noir, Delaware, Fredonia, Herbemont, Isabella, Jacquez, Juliana, Landot Noir, Niagara, Noah, Norton, Oberlin, Patricia, Seibel, and Venus.

<sup>9</sup> Of the 1271 prime varieties identified for 2010, the most popular country of origin is Italy with 328, followed by Portugal (196), France (120), and Spain (88). Then three other countries contribute between 55 and 70 varieties each (Hungary, the United States and Croatia). Most of the remaining varieties are from Southeastern Europe and the countries surrounding the Black and Caspian seas (Table 19).

Another way to consider varietal concentration is to review the share of the top variety or the cumulative shares of the top few varieties globally and in a country's total area of winegrapes. Globally, the top 35 varieties accounted for 59% of the world's winegrape bearing area in 2000 but by 2010 that share was 66%. At the national level, in 2010 as many as 12 of our 44 countries have more than one-third of their total area under just their top variety; but perhaps even more striking is that **only 6 of the 44 countries have less than one-third of their total winegrape area under their top three varieties**. Those numbers of countries had changed from 7 and 7 in 2000, respectively, again indicating a rapid increase in varietal concentration (Tables 23 and 24), as already noted globally in Charts 7 and 8.

Tables 25 and 26 record the source of the prime name and main synonym if any for each variety (and thus also its country of origin). The Robinson, Harding and Vouillamoz (2012) volume is the source of close to 90% of named prime varieties in our database, with just 2% from [www.vivc.de](http://www.vivc.de). As for the rest (just 6% in 2010), they have not been identified in either of those sources and so are assumed to have the name and origin of the country in which they are recorded.

Given the heavy concentration in just a few varieties in each country, Tables 27 to 42 provide details for the world's top 30 reds, top 30 whites, and top 6 other (greyish) coloured winegrapes. They reveal which varieties are dominating the vineyards of each country. For example, Table 29 shows that almost one-third of France's area was devoted to what were the three top reds globally in 2000, namely Cabernet Sauvignon, Garnacha Tinta and Merlot.

### **Varietal Intensity Indexes and global varietal shares**

The Varietal Intensity Index is defined by Anderson (2010) as a variety's share of a region's total winegrape area divided by that variety's share of the global winegrape area. This index is thus a complement to national share information in that it indicates the importance of a variety in a region not relative to other varieties in that region but rather relative to that variety in the world. It also complements information on a country's share of the global area for a variety: like that share, the VII can change for a region – even if its area remains unchanged – when that variety's area in the rest of the world changes.

That complementarity is exposed in Tables 43 to 46. In Tables 43 and 44, for example, the top 45 varieties for each country are shown in order of their national share in 2000 or 2010, and alongside that is shown the country's global share of that variety and its Varietal Intensity Index. For example, France's total area and varietal mix altered relatively little over the decade to 2010, yet its VIIs altered considerably. On the one hand, the VIIs for its four biggest varieties of French origin (Merlot, Syrah, Cabernet Sauvignon and Chardonnay) each fell by 10% or more, in each case because bearing areas of those varieties expanded considerably in the rest of the world. On the other hand, France's VIIs for two of its three biggest varieties of non-French origin (Garnacha Tinta and Trebbiano Toscana) rose by about 10%, in those cases because their bearing areas fell much more in the rest of the world than in France. Mazuelo was the big exception: its area in France fell 45% over that decade, compared with a fall of 37% globally, so France's VII for that variety VII fell (from 4.3 to 3.6).

By contrast, the global area of each of Spain's seven biggest varieties apart from Tempranillo contracted, and so even though the Spanish areas of each of those seven also

contracted, the contractions were smaller in Spain than globally and hence Spain's VII rose for almost all of them (the exception being Garnacha Tinta, whose VII fell slightly).

Another example of global interest relates to Argentina, where Cot (main synonym: Malbec) was the country's 3<sup>rd</sup> biggest variety in 2000 but its biggest in 2010 (15.4% of the national winegrape area), when it accounted for 76% of the world's Cot plantings. Since that variety represented only 0.88% of the global area of all varieties in that year, Argentina's Varietal Intensity Index for that variety was  $(0.154/0.088 =) 17.5$  in 2010. But that was only slightly larger than its VII of 16.2 in 2000, because over that decade the global area of Cot rose by two-thirds. Note also that for Argentina, Cot is not even ranked in the top 25 varieties in terms of VIIs in 2010 (Table 46), because there are numerous varieties that are unique to Argentina and that therefore have the even higher VII of 23. (When a variety is grown only in one country, its VII is necessarily the inverse of the proportion of the global winegrape area accounted for by that country – and so is identical for each unique variety in that country and year.)

To illustrate the difference between the national share of a variety and its VII, consider as a further example the national shares and the VII's for Syrah (main synonym: Shiraz). This is the most important variety in Australia, and its share of Australia's total winegrape area has risen from 22% to 28% in the decade to 2010. However, Charts 23 and 24 reveal that Syrah has become more important in numerous other countries as well since 2000. Its share of the global vineyard area thus rose from 2.1% in 2000 to 4.0% in 2010. As a result, Australia's share of Syrah's global area has fallen from 29% to 23% (Chart 25) and so Syrah's VII for Australia has fallen from 11 to 7 over that decade (Chart 26).

Even so, Australian regions continues to dominate the list of the top 25 regions in the world in terms of regional VIIs for Syrah – just as regions within the United States dominate the list for Tribidrag (main synonym: Zinfandel), Spanish regions dominate the Airen list, and Argentinean regions dominate the Cereza list (Tables 47 to 53).

The fall in the VII for Australia is not unique to Syrah. Indeed of all 15 varieties for which there were more than 1000 hectares in Australia in 2010, there are only four whose VII has risen since 2000 (Chart 27). Only a small fraction of that can be explained by Australia's share of the global area becoming larger, since its share has risen only marginally over that decade (from 2.7% to 3.3%). The much more important reason for the VII falling for most of the key varieties in Australia is that the country's mix of varieties is becoming more similar to the global average. The next section provides a way of quantifying the extent of varietal mix similarity of regions and countries with the world (and also with each other).

## **Varietal Similarity Indexes**

While the Varietal Intensity Index is helpful in indicating the extent of specialization of a region or country in any particular variety vis-à-vis the rest of the world, it is also helpful to have a measure of how similar or different a region's overall mix of varieties is to that of other regions or the world. For that purpose an index of similarity of varietal mix between regions or countries or over time has been developed. As defined and explained in the Technical Notes at the front of this volume, this Varietal Similarity Index provides an indication of how closely the shares of different varieties in the winegrape area in one location match the shares in another location or in the world (or in that same location in

another time period). The closer (further away) that match, the closer the index is to one (zero). That is, the index will be zero for pairs of regions with no overlap in their winegrape varietal mix, and one for pairs of regions with an identical varietal mix. For the in-between cases, the index is conceptually similar to a correlation coefficient. Like a correlation coefficient, it is completely symmetric so the results can be summarized in a symmetric matrix with values of 1 on the diagonal, plus a vector that reports the index for each region relative to the global varietal mix.

Various questions can be addressed with the help of this Varietal Similarity Index (VSI), given the heterogeneity across regions and even countries in their winegrape varietal mixes. The most obvious is: how similar is each country to the global average mix of varieties? The range of national-world VSI's is quite wide (Tables 54 and 55), with a handful of countries above 0.55 and another handful below 0.15. Not surprisingly, the mix in France is closest to the global mix, but there have been major changes since 2000: France's is now closer to the world average, reflecting the fact that many other countries have adopted more French varieties over that decade. That global move toward French varieties has also contributed to the sharp rise in the VSI for the United States and the small drop for Spain. Australia's VSI has risen in part because so many other countries have expanded their plantings of Australia's most-popular variety, namely Syrah.

The fact that the VSI with the world rose between 2000 and 2010 for each of the five biggest New World countries and for two of the three biggest Old World countries (Chart 28) is a further reflection of the recent increase in varietal concentration in the world's vineyard over that decade. Meanwhile, the VSIs for many of the former communist countries of the Old World have fallen substantially since 2000 as those countries continue to restructure their vineyards and move toward more-profitable (including local) varieties. Hungary, for example had just under a quarter of its winegrape area under varieties of Hungarian origin in 2000, but by 2010 that share was 37%. The countries with the lowest VSIs vis-à-vis the world include those that are highly specialized in just white wines (e.g., Austria, Georgia, Luxembourg).

The VSI is also useful for indicating, for any one region or country, how close its varietal mix in 2010 is to that in 2000. Chart 29 lays that out for each country for which there are comparable data for the two periods. While some countries have an across-time VSI close to one (Switzerland 0.99, France and Austria 0.97), others are much lower (United Kingdom 0.32, Russia 0.25) which reflects considerable changes in their varietal mix of bearing areas over that decade.

The main use of the VSI is in examining the extent to which a region or country has a varietal mix similar to that of other regions or countries. In both 2000 and 2010, the New World countries have varietal mixes closest to other New World countries, whereas the varietal mixes of Old World countries are closest to one of their neighbours (Table 57 and 58, including last rows). The latter is especially the case among the countries of Eastern Europe and the former Soviet Union. This shows up in Chart 30, which ranks countries according to their VSI with the country that has the closest varietal mix to theirs: eleven of the first 14 countries are former communist countries of the Old World, and their closest-matched country is also from that region – as are several of their other nine closest-matched countries shown in Table 58. So even though those countries tend to have varietal mixes very different from the world average (they are biased toward the right-hand side of Chart 28), those mixes are very similar to each other. By contrast, several West European countries have no other country with a similar varietal mix, notably Italy, Portugal, Spain and Greece. Such varietal

distinctiveness may or may not be a good thing economically, depending on how unique their terroir is and how valued their varieties are by consumers.

There are of course considerable differences in varietal mixes between regions within each country as well. For example, the VSIs across the regions within Australia, even vis-à-vis the world, range from 0.30 to 0.70 in 2010. That information may be helpful for producers in that region thinking of altering their varietal mix or re-locating to a region with a higher latitude or altitude so as to maintain their firm's current varietal mix in the wake of global warming. Tables 59 and 60 show that for some countries such as Italy, the regions with the closest mix to theirs are neighbouring Italian regions, whereas the closest matches for many French regions are in other countries.

### **Summary data for each key variety and country**

To assist readers wishing to focus on a particular variety or country, Section VIII of the tables provides, in alphabetical order, a one-page graphical summary of information about each of the world's top 50 varieties, while Section XI provides, again in alphabetical order, a one-page summary of information about each of the 44 countries in the database.

### **Final word**

While this volume provides a great deal of information about which winegrapes have been grown in various regions during the first decade of the 21<sup>st</sup> century, it leaves open the question of *why* those varieties have been produced where they are. Is it driven mainly by what grows best in each location (the terroir explanation)? Gergaud and Gingsburgh (2008) argue that even in Bordeaux that has not been the main explanation. Is the increasing concentration on major French varieties because non-French producers – particularly in newly expanding wine-producing countries – find it easier to market them because of France's strong reputation with those varieties? Might part of the explanation be that those varieties do well in a wide range of growing environments, or have been found to be desirable for blending with the traditional varieties of a region? These and other centripetal forces during the first decade of this century apparently have dominated the possible centrifugal forces mentioned at the start of this Introduction. It remains to be seen whether the latter will be strong enough to dominate the former over the next decade or so. If China is the country with the greatest expansion of winegrape area in the next few years, and if its new plantings continue to concentrate on key French red varieties, the concentration of the world's varietal mix may continue to increase for some time yet.

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