

**WHERE IN THE WORLD ARE VARIOUS WINEGRAPE
VARIETIES GROWN? EVIDENCE FROM A NEW DATABASE**

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April 2014

Abstract

*The **purpose** of this paper is to alert readers to a new, freely available, database that provides information on which winegrape varieties are grown in what regions of the world. Its **approach** is to report vine bearing areas and a range of indicators in two periods (circa 2000 and 2010) for more than 2000 varieties, of which nearly 1,300 are 'primes' and the rest are their synonyms. The data refer to 611 regions in 44 countries that together account for 99 percent of the world's wine production. To aid use of the database, there is an accompanying e-book that contains dozens of charts and more than 150 tables that report shares and other indicators to summarize developments in winegrape bearing areas over the first decade of this millennium. The **findings** include several non-trivial changes that have taken place over this period, perhaps the most striking being the increase in the share of the global area that is devoted to red varieties, which has risen from 49% to 56%. Cabernet Sauvignon and Merlot are now the most-planted varieties, pushing Airen into 3rd place, and Tempranillo and Syrah now 4th and 6th, having been 24th and 35th in 1990. Another striking finding is the increased concentration in plantings, particularly on French varieties. In 2000, 21 varieties accounted for half the bearing area globally, but by 2010 that number had fallen to 15. In the New World the top 7 varieties cover half the area. One **practical value** of the database is that it reveals how similar each region is to other regions and to the world in terms of their varietal mix, and how rapidly each region is changing its relative position globally. This is important as producers seek to boost their competitiveness in the wake of wine's globalization by exploiting their geographical and varietal distinctiveness.*

Key words: Winegrape bearing area, Regional specialization by variety, Varietal intensity index, Varietal similarity index

WHERE IN THE WORLD ARE VARIOUS WINEGRAPE VARIETIES GROWN? EVIDENCE FROM A NEW DATABASE

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I. INTRODUCTION

Globalization of the world's wine markets over the past two or three decades has added to both the opportunities and competitive challenges for producers seeking to differentiate their product to attract the attention of discerning consumers (Anderson 2004). The traditional practice of displaying regional names on wine bottle labels is increasingly being supplemented by grape varietal names. Its commercial success, especially for lower-priced New World wines, has led to some freeing up of labelling laws in the European Union to allow that practice. Meanwhile, producers in the New World are realizing the marketing value of following Europe's traditional producers in going beyond country of origin to regional and sub-regional labelling so as better differentiate their product.

In addition to striving to product-differentiate, producers are also well aware of the impact climate change is having on their winegrapes. Adaptation strategies include switching to warmer-climate or more-resilient grape varieties, and re-locating to regions at higher latitude or altitude so as to be able to retain the firm's 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 new opportunities for breeders, which is increasing their interest in exploring traits of little-known varieties.

Also of concern is that the diversity of winegrapes is narrowing to a few 'international' varieties. Some vigneron in the Old World are beginning to respond by reverting to neglected local varieties, while in the New World a small but growing group of producers are exploring alternatives to the dominant varieties. How concentrated is the current bearing area compared

with earlier times, and how different is that concentration in the Old World compared with the New World?

Such biodiversity concerns, together with the above 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. Wine atlases such as Johnson and Robinson (2013) provide a great deal of information about where winegrapes are grown, and Robinson, Harding and Vouillamoz (2012) draw on the latest DNA research to provide a detailed guide to the world's commercially grown 'prime' varieties and their various synonyms. However, 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.¹

To fill this lacuna, we have compiled such a global database and provide several indicators to capture changes over the first decade of this century in the varietal mix of the world's wine regions (Anderson and Aryal 2013). Its features include the following:

- it has data for 2010 as well as 2000, plus some limited varietal data for the world in 1990;
- it covers 44 countries which together account for 99 percent of global wine production;
- it has 611 regions and more than 2,000 varieties (of which nearly 1,300 are 'primes' and the rest are their synonyms); and
- it has removed spurious differences in varietal mixes resulting from different varietal names being used for what have been shown recently to be DNA-identical varieties; and
- it is accompanied by an e-book (Anderson 2013) that contains dozens of charts and more than 150 tables that report shares and other indicators to summarize developments in winegrape bearing areas over the first decade of this millennium.

The purpose of this paper is to provide a brief guide to the types of information compiled in this new database and in an accompanying e-book (Anderson 2013). Section II of the paper describes the database in more detail. Section III then provides an empirical picture of the changing varietal distinctiveness of the world's wine regions. This is necessarily very selective, but at least it provides a sense of the breadth of the database. Because of the Bulletin's space limitations, it is not possible to also highlight here the depth of the database in terms of its within-country regional detail.

II. THE GLOBAL DATABASE

¹ 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. Anderson (2010) assembled a preliminary database for a dozen countries and covered 166 regions and 258 varieties, but many of those varieties were not unique as that study did not re-name the synonyms of primes.

Most key wine-producing countries provide some data on bearing area of winegrapes by variety and region. Data for most of the member countries of the European Union 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. Key exceptions are the United States and Canada, whose data are collected at the state/provincial level and only for those jurisdictions with significant wine production.

The database relates to two periods: the turn of the century, and a decade later. The reason for choosing those periods is that they correspond to the most-recent decadal agricultural census periods of the European Union, which were 1999 or 2000 and 2009 or 2010. In the case of non-EU countries, data have been sought for the earlier year in the Northern Hemisphere and the latter year in the Southern Hemisphere, in which the data refer to vintages that were only 6 months apart (although not all other countries or regions had data for exactly those years).

Table 1 lists the 44 countries included and the number of winegrape regions and prime varieties within each of those countries for which bearing area data are available in the two chosen periods.² The availability of area data by region within each country varies considerably across countries, and is not identical in the two periods. 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 by 2010 for what is now the state with the second-largest winegrape area, Washington. 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. 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 relative importance of those countries in the global bearing area of winegrapes and in global wine production is shown in Table 2. That table also shows the other countries reported by FAO to be producing wine, which collectively account for just 1 percent of global wine output (1.06% in 2000, 0.96% in 2010). So as to be able to estimate the global winegrape area, we assume that 'Rest of the world' group's share of the world's winegrape area is the same as its share of world wine production in each of our two periods (see second-last row of Table 2). There are some other countries (especially in the Middle East) that are substantial grapegrowers, but the vineyard areas devoted to table and drying grapes are ignored here.

As for winegrape varieties, our key source for identifying DNA-identical varieties is Robinson, Harding and Vouillamoz (2012). It provides a detailed

² The number of varieties reported to Eurostat by Germany was 57 in 1999 and 48 in 2009, but more-detailed data are available nationally at www.germanwines.de. Our database was revised in April 2014 to incorporate those more-detailed varietal data (which raise the relative importance of red varieties), and the tables and figures below have been revised to incorporate those changes.

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 currently perceived country or region of origin.³ In addition, the *Vitis International Variety Catalogue* (JKI 2013) provides additional DNA-based varietal information. The Robinson/Harding/Vouillamoz 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. The list of varieties maintained by the OIV (2012) was not used because it is based on the names used in member countries and thus does not identify primes. 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 known synonym.

All but a few winegrape varieties (and 1% of the total global area) are from the *Vitis vinifera* species.⁴ Berry colours are adopted from Robinson/Harding/Vouillamoz, although we simplified 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).⁵

Reliable area data for 2000 were unavailable for nine of those 44 countries (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). Nonetheless, to capture their unusual varietal contributions in the earlier period, they are included as a group (called "Missing 9 in 2000") by assuming each of them had (i) the same varietal mix 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.

³ There are two exceptions to our use of 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: 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: Garnacha Blanca, Garnacha Peluda, Garnacha Roja, and Garnacha Tinta.

⁴ 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. More than half of those are in Brazil, and one-sixth are in each of Moldova and the United States.

⁵ Numerous countries have an 'other varieties' category for each region, some of which may include varieties that are not *Vitis vinifera*. Only some countries 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.

The number of regions is not the same for each country in the two periods, which means that some regional detail is necessarily lost through aggregation when we seek to compare varietal mixes of each region in the two sample years. Even so, there is as many as 410 matching regions globally. In the next section we will have space to report only the extent of similarity of varietal mixes between countries, however. 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). For simplicity all other countries are considered here as the New World. The latter therefore include, somewhat unusually, the Asian winegrape-growing countries for which we have data (China, Japan, Myanmar and Thailand), although their winegrape area in aggregate is still small.

In short, the database involves two years (2000 and 2010), up to 611 regions (in 44 countries), and up to 1289 varieties (once synonyms are re-named). It is thus possible to slice this three-dimensional database (which has 1.3 billion cells, but of course the bearing area in many of those cells is zero) in any of three ways: across regions, across varieties, or across years. There are also some global data for the 50 or so most important varieties for 1990, drawn from Fagen (2003).

To assist in digesting such large spreadsheets, we summarize the data through calculating numerous shares and a pair of share-based indexes.

III. A SELECTION OF FINDINGS

In this section the macro picture of developments in the global vineyard, in terms of the changing diversity of winegrape varieties, is first presented. Attention then turns to two sets of indicators. One 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 (called the Varietal Intensity Index). The other measures the extent to which the varietal mix of one region or country matches that of another region or country or the world (called the Varietal Similarity Index).

III.1 The global macro picture

Countries differ markedly in their winegrape bearing areas with the big three, Spain, France and Italy, accounting 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,⁶ 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

⁶ The value data are estimated for 2009 by Anderson and Nelgen (2011, Table 175).

and Spain in terms of pre-tax value of wine production, followed by Germany and Australia (Figure 1). 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.

There is also 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 (Figure 2).

The global area of winegrapes has declined by almost 6% over the first decade of this millennium, adding to the 8% fall in the final decade of the 20th century. This is despite increases of around 30% in the United States and Georgia, 40% in the Czech Republic, and 220% in New Zealand in the most recent decade. The biggest falls were in Spain (13%), Portugal (20%) and several countries in southeastern Europe (Table 3).

Turning to the global area under different varieties, the data reveal that the extent of varietal concentration in the world's vineyard has increased non-trivially over the decade to 2010. Half the world's plantings in 2000 were accounted for 21 varieties but, by 2010, that total had dropped to 15 varieties. This varietal concentration is more apparent in New World countries, where the top seven varieties account for over half of all plantings, whereas 16 varieties are needed in the Old World to get to the half-way point (Figure 3).

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. Cabernet Sauvignon and Merlot have more than doubled their shares to take them from 8th and 7th to 1st and 2nd places, and Tempranillo and Chardonnay have more than trebled their shares to take 4th and 5th places, while Syrah has jumped from 35th to 6th. 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 1st to 3rd, Garnacha from 2nd to 7th, and Trebbiano from 5th to 9th. The fastest-growing and fastest-contracting varieties are depicted in Figure 4.

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 (Figure 5). 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 (Figure 6). The two largest non-red/white varieties are Cereza, whose global ranking over that decade fell slightly from 30th to 34th, and Pinot Gris/Grigio, whose global ranking rose very considerably from 44th in 2000 to 19th by 2010.

In aggregate these changes have meant that the overall share of red

varieties in the global winegrape area has risen considerably, from 49% to 56% in the decade to 2010. 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; 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 (Figure 7). Of the countries that have increased the share of red varieties in their national mix, the majority are in the Old World. 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. Within the red and white winegrape categories, the varietal concentration summarized in Figure 3 has increased almost equally for red and white winegrapes over the 2000 to 2010 period.

Another way to express varietal concentration is to examine the share of global area devoted to varieties by their country of origin. Between 2000 and 2010 the global winegrape share devoted to varieties of French origin rose from 26% to 36%. French varieties are especially dominant in the New World's vineyards, where their share averaged 67% in 2010, up from 53% in 2000; but they also increased their share of Old World's vineyards, from 20% to 27% over that decade. Spain is the next most important country of origin, 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%. Italian varieties are third at 13%, the same as Italy's share of the global area.⁷ Portugal's are fourth at 3%, followed by Croatia's and Germany's at a little over 2% each.

Declining varietal diversity is also reflected in the share of the total area of winegrapes for a country or the world that is held by the top variety, or the cumulative shares of the top few varieties. 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, as many as 12 of the 44 countries in 2010 (up from 7 in 2000) had more than one-third of their total area under just their top variety. 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.

III.2 Varietal Intensity Indexes

Attention can now turn from the above macro picture to examining the extent to which individual regions or countries are differentiating themselves from others by specializing in certain varieties. In doing so it is helpful to

⁷ In terms of *number* of varieties, however, Italy's global winegrape share is more than three times that of Spain. Of the nearly 1300 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 Sea.

calculate a Varietal Intensity Index (VII), 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 the regional or 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 as a whole. It also complements information on a region's or 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.

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 3rd 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 VII 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, 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.)

As a final example, consider Syrah (main synonym: Shiraz). This is the most important variety in Australia, and its share of Australia's total winegrape area rose from 22% to 28% in the decade to 2010. However, because Syrah has become more important in other countries as well, its share of the global vineyard area has almost doubled, rising 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% and so Syrah's VII for Australia has fallen from 11 to 7 over that decade. 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.

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. 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 main reason for the VII falling for most of the key varieties in Australia is that – as with France – the country's mix of varieties is becoming more similar to the global average. The next sub-section provides a way of quantifying the extent of varietal mix similarity of regions and countries with the world (and also with each other).

III.3 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 would also be 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 (Anderson 2010), adapting an approach introduced by Jaffe (1986). This index provides an indication of how closely the shares of different varieties in the winegrape bearing 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 any 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, with a handful of countries above 0.55 and another handful below 0.15 (Figure 8). 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 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. Figure 9 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 4, including last rows). The latter is especially the case among the countries of Eastern Europe and the former Soviet Union. This shows up in Figure 10, 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 five closest-matched countries shown in Table 4. 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 Figure 8), 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, as detailed in Section VII of Anderson (2013) where information is presented for more than 500 regions within 29 of the 44 sampled countries. For example, the VSIs across the regions within Australia, even vis-à-vis the world, range from 0.30 to 0.70 in 2010. Such regional VSI information may be helpful for producers 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.

IV. POSSIBLE EXTENSIONS TO THE DATABASE

This paper provides just a few snapshots of a great deal of the newly assembled information on which winegrapes have been grown in various parts of the world during the first decade of the 21st century. It does not explain *why* those varieties are produced where they are though. Is it driven mainly by what grows best in each location (the terroir explanation)? Are non-French producers concentrating on major French varieties because – particularly in newly expanding wine-producing countries – France’s strong reputation with those varieties makes it easier for them to market their product? Do those varieties just happen to do well in a wide range of growing environments? Have they been found to be desirable for blending with traditional varieties of a region? These and myriad other questions can be addressed more easily now that a comprehensive global database of winegrape bearing areas. Furthermore, hopefully that database will be built on in the years ahead as more countries assemble new data that are more disaggregated regionally and by variety.

Acknowledgements

The authors are grateful for financial assistance from Australia’s Grape and Wine Research and Development Corporation (Project Number UA 12/08). Views expressed are theirs alone.

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Figure 1: National shares of global winegrape area, wine production volume and wine production value, 2010 (%)

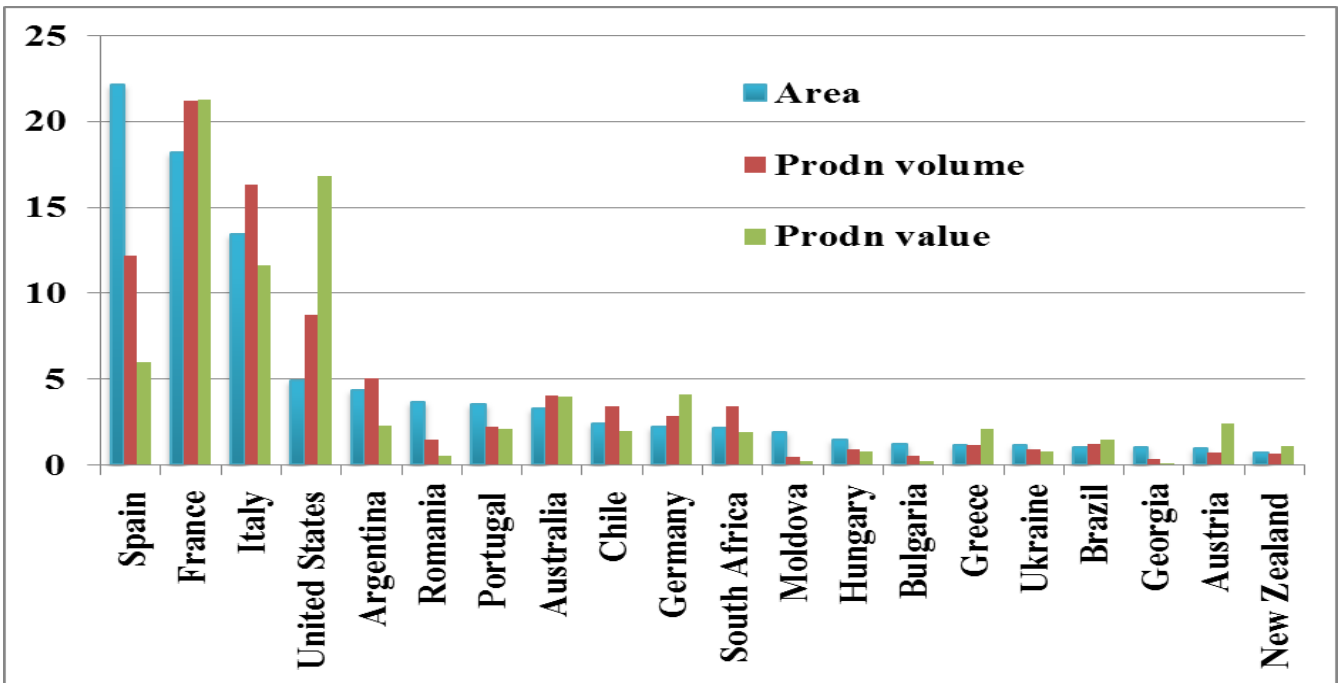


Figure 2: Share of total agricultural crop area under winegrapes, 2009-11 (%)

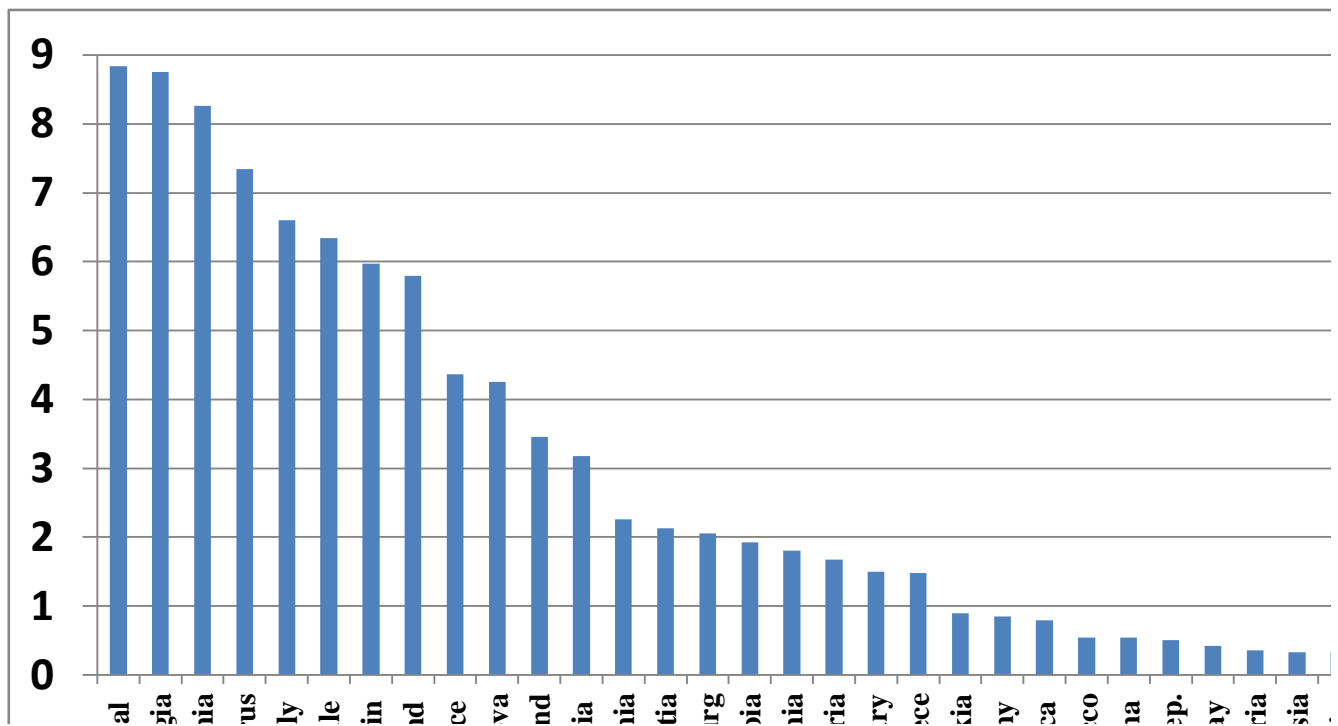
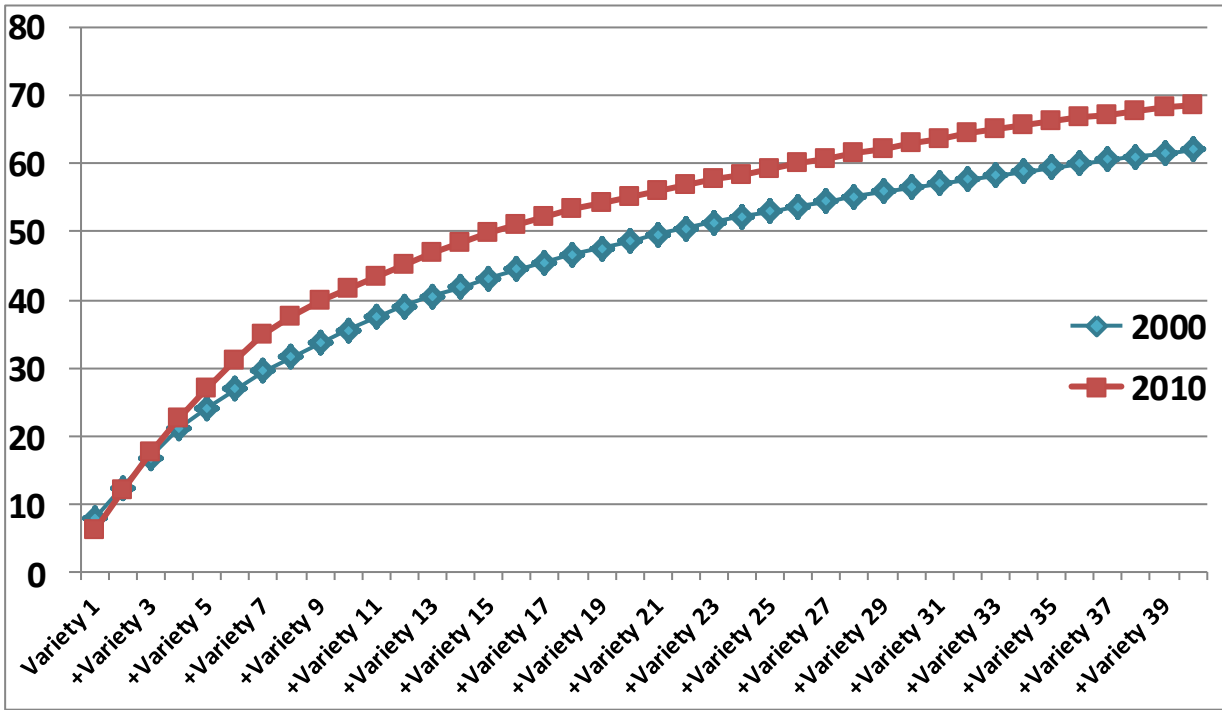


Figure 3: Cumulative varietal shares of global winegrape area, 2000 and 2010 (%)

(a) All countries



(b) Old World and New World countries

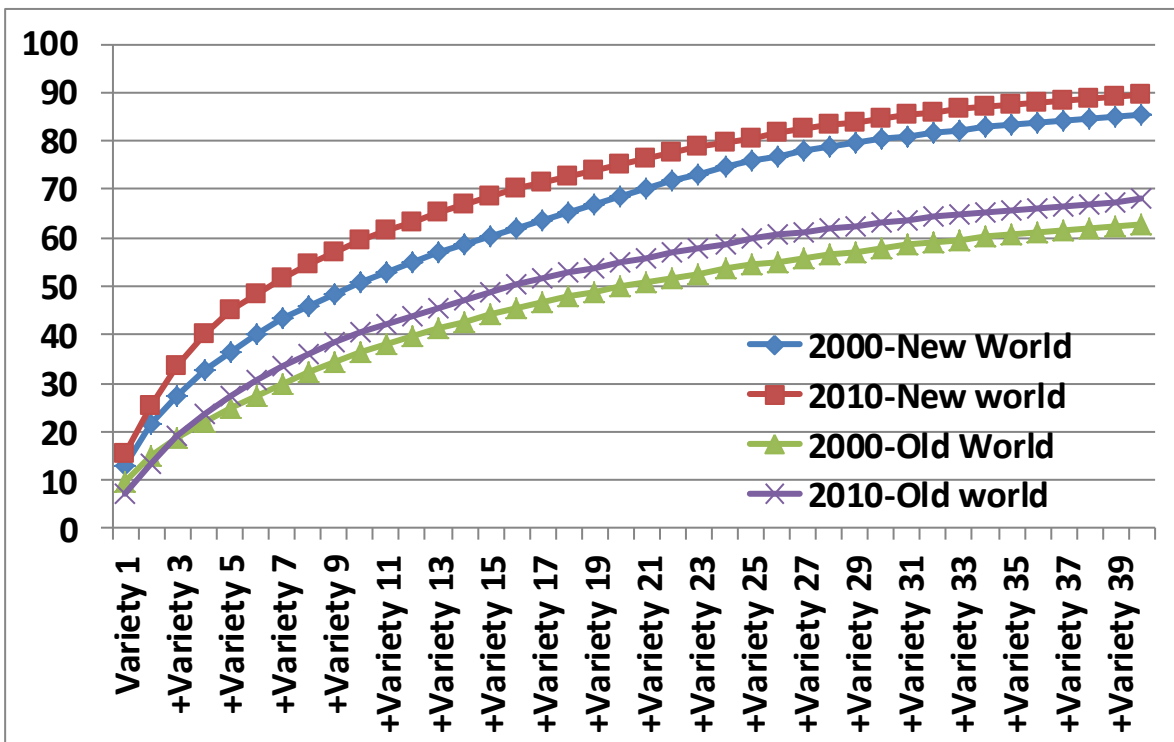
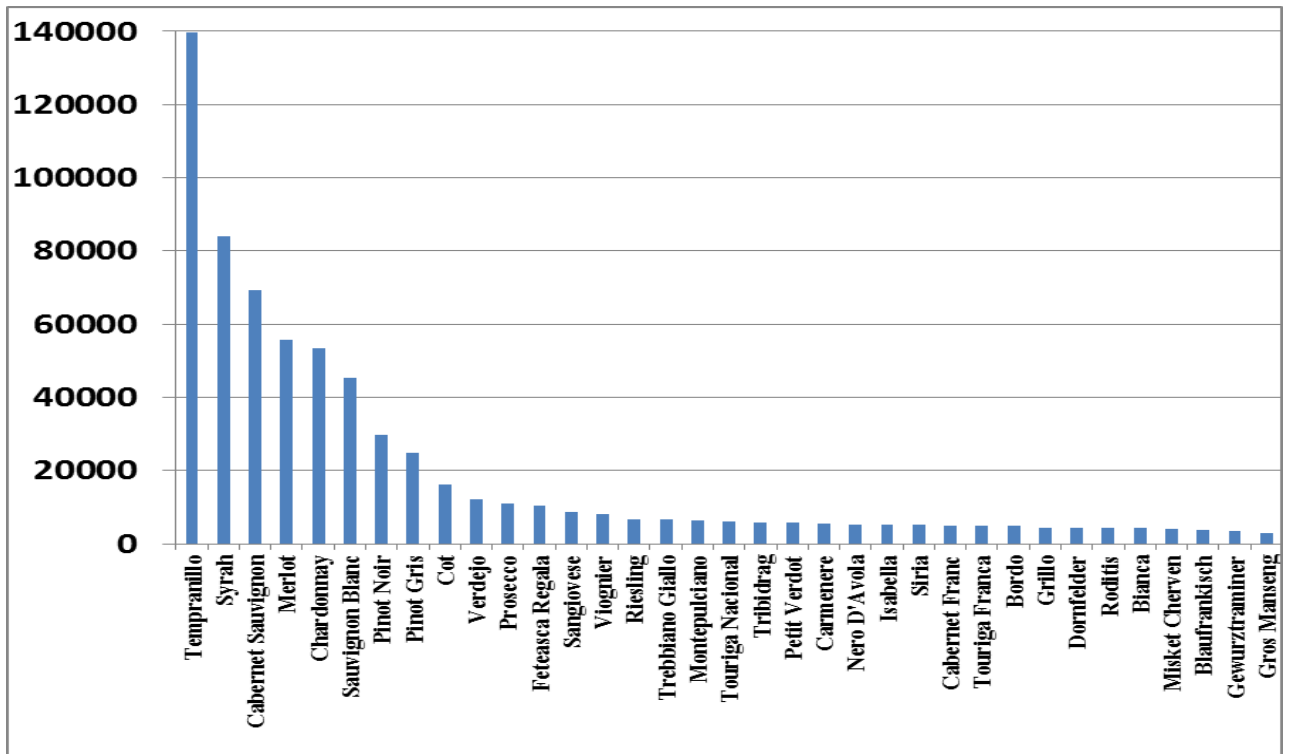


Figure 4: World's fastest-changing winegrape varieties, 2000 to 2010 (ha)

(a) Fastest-expanding



(b) Fastest-contracting

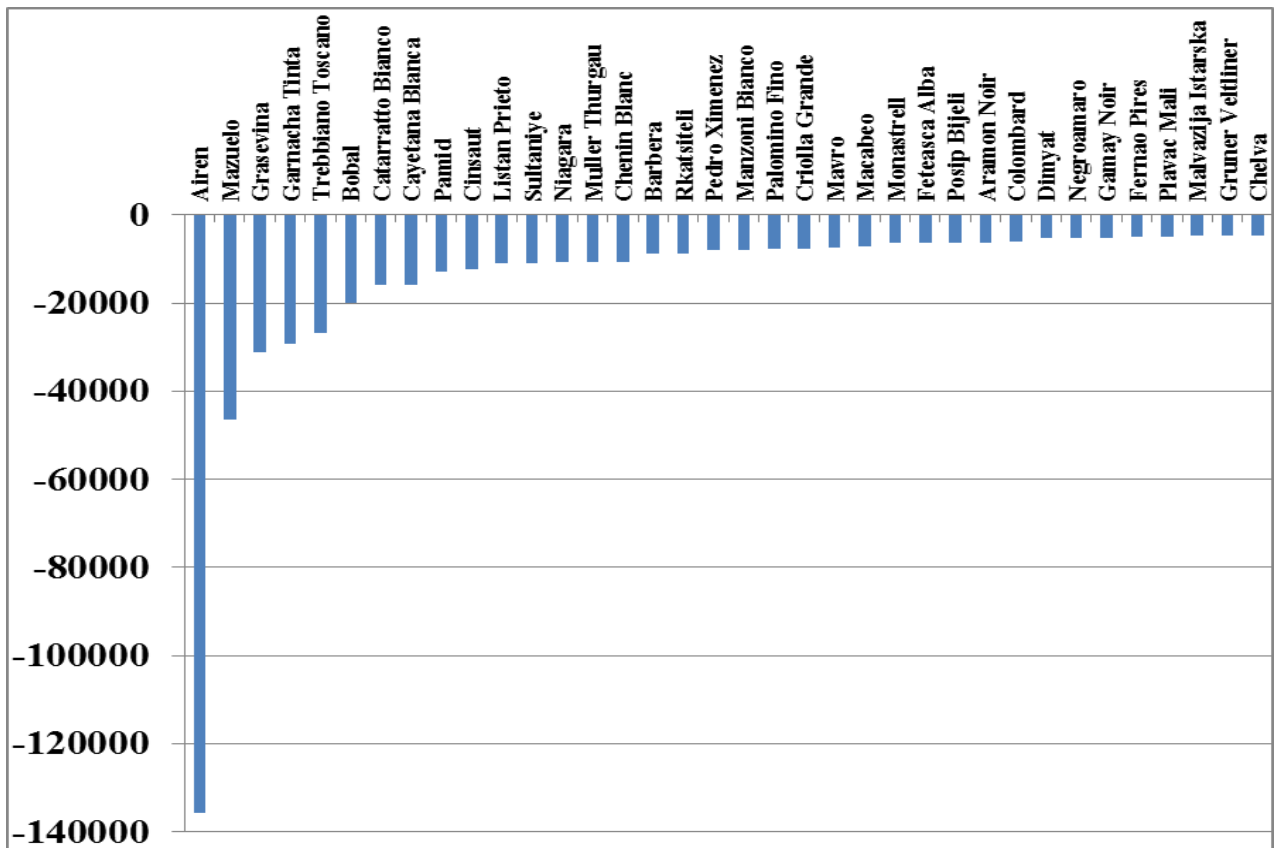
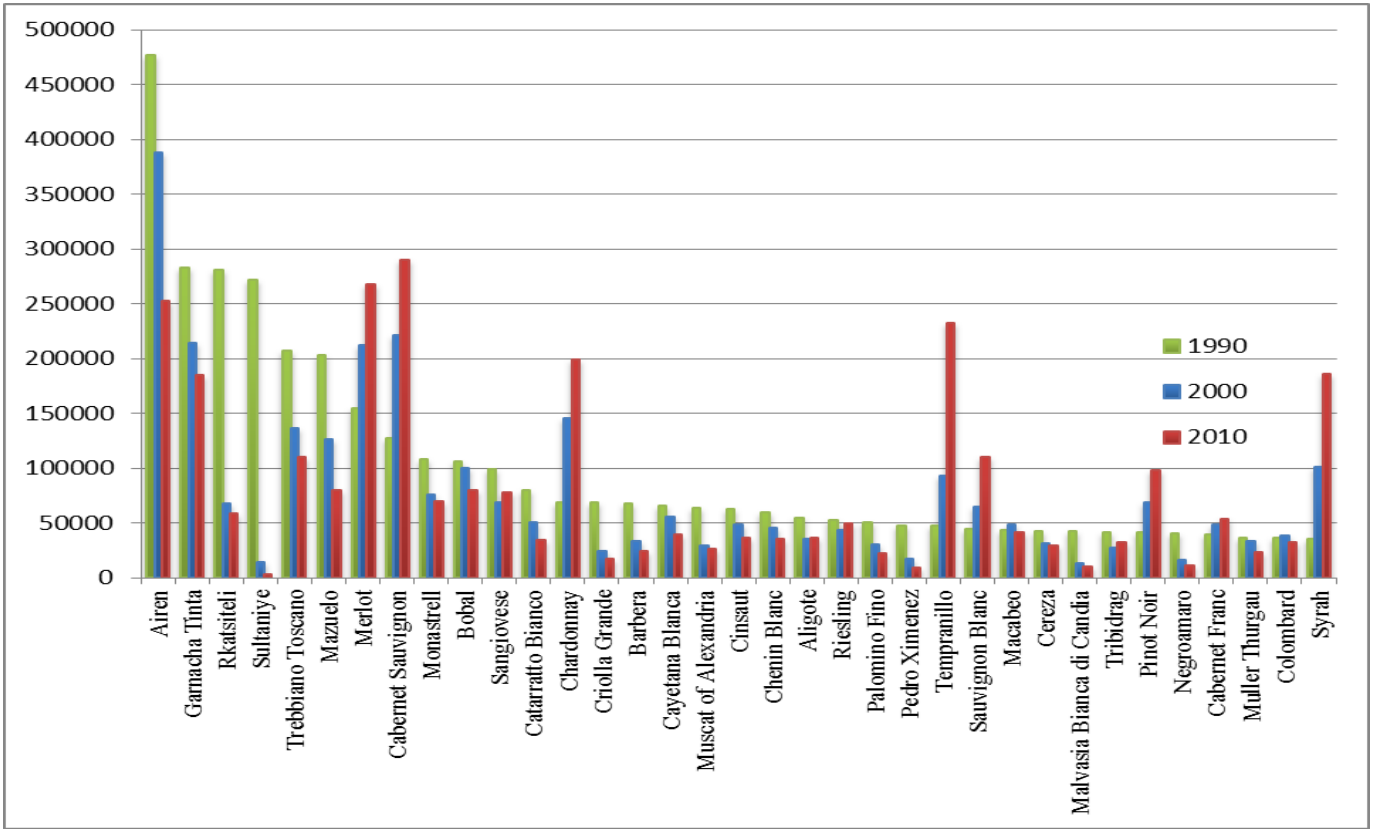


Figure 5: World's top 35 varieties in 1990, 2000 and 2010 (ha)

(a) Ranked by 1990 area



(b) Ranked by 2010 area

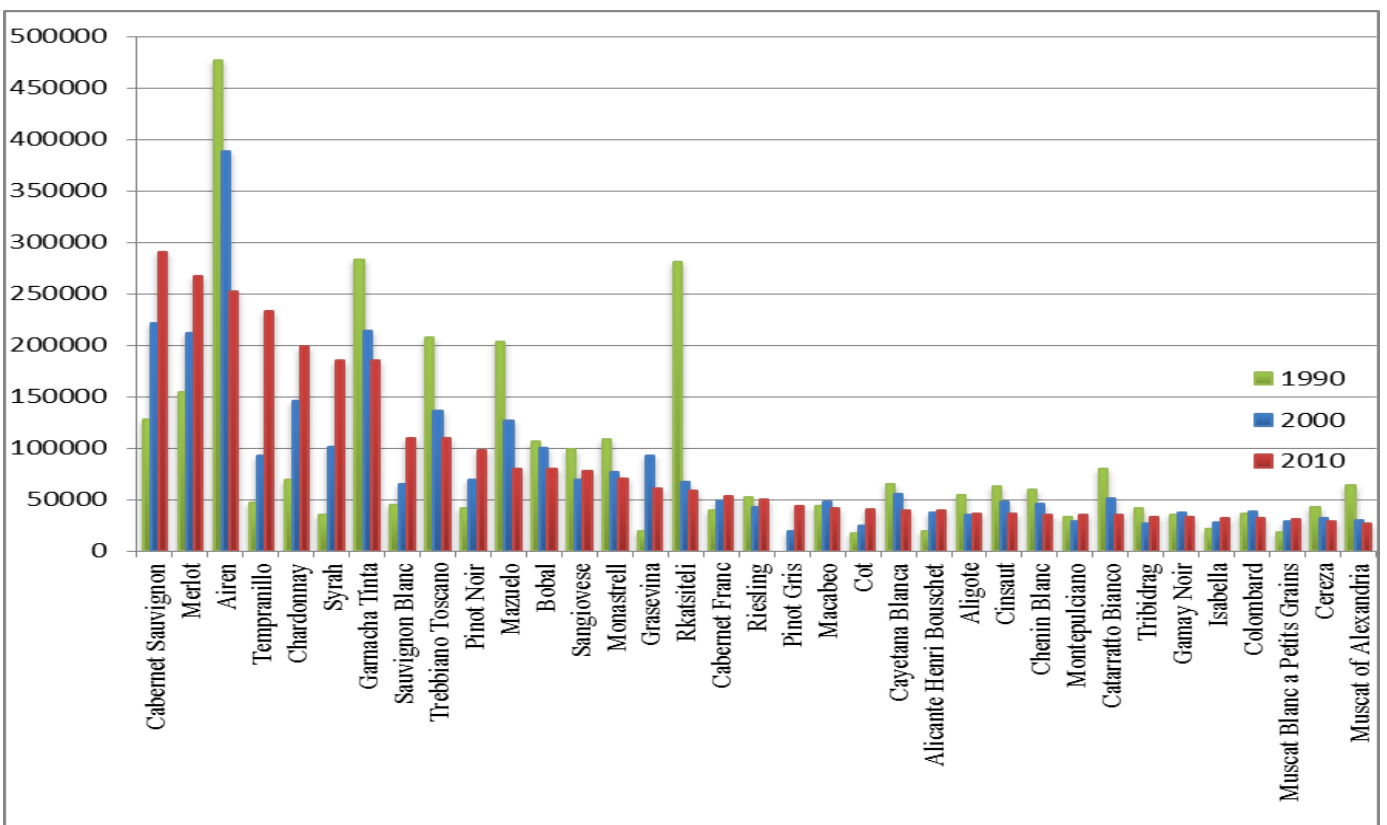
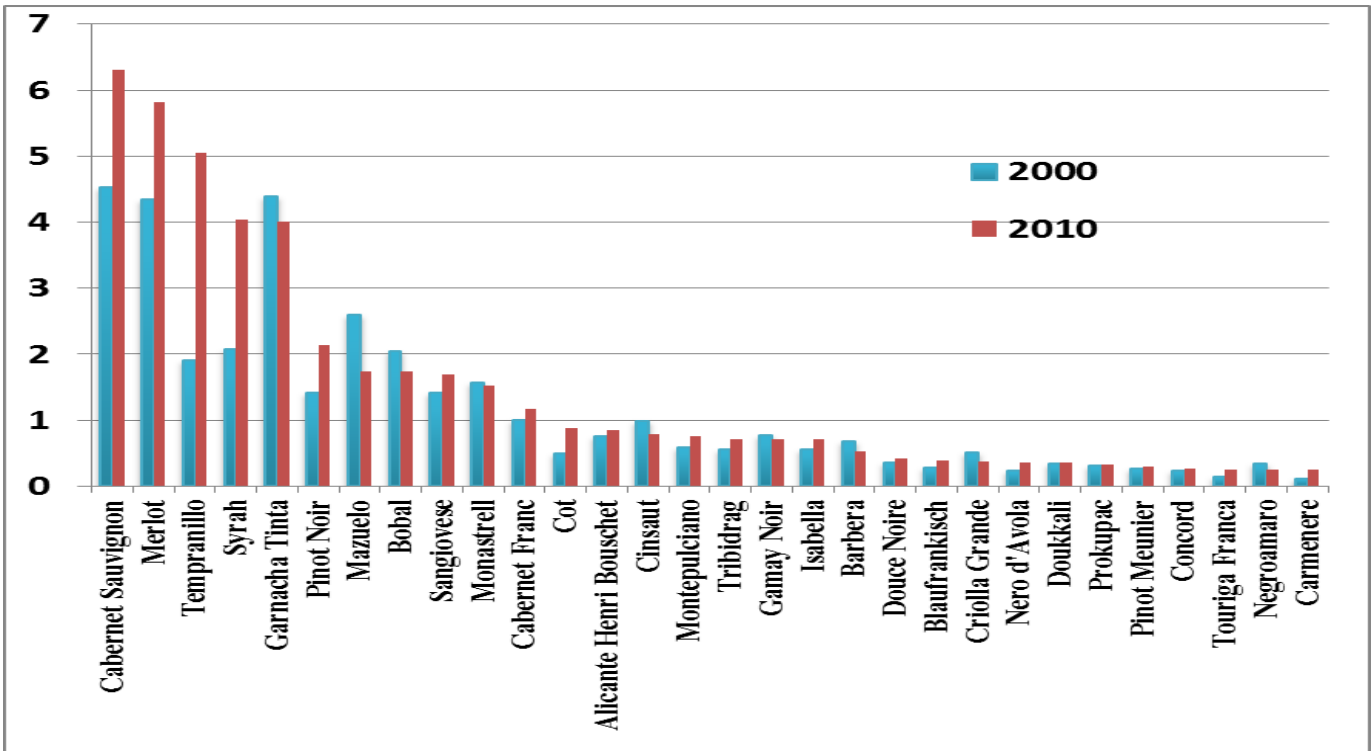


Figure 6: Top 30 red and top 30 white varieties' shares of global wine area, 2000 and 2010 (%)

(a) Reds



(b) Whites

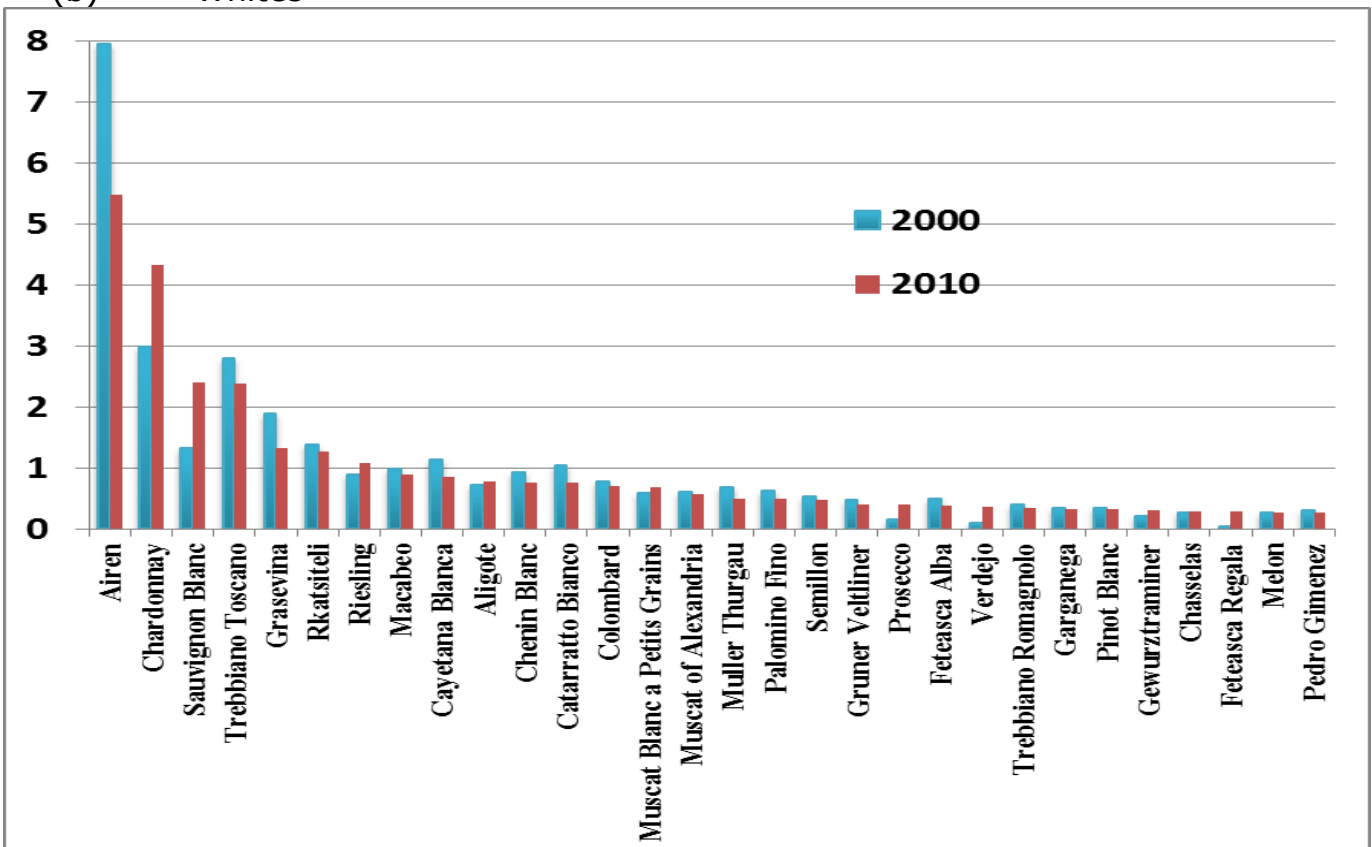


Figure 7: Shares of red varieties in national winegrape area, 2000 and 2010 (%)

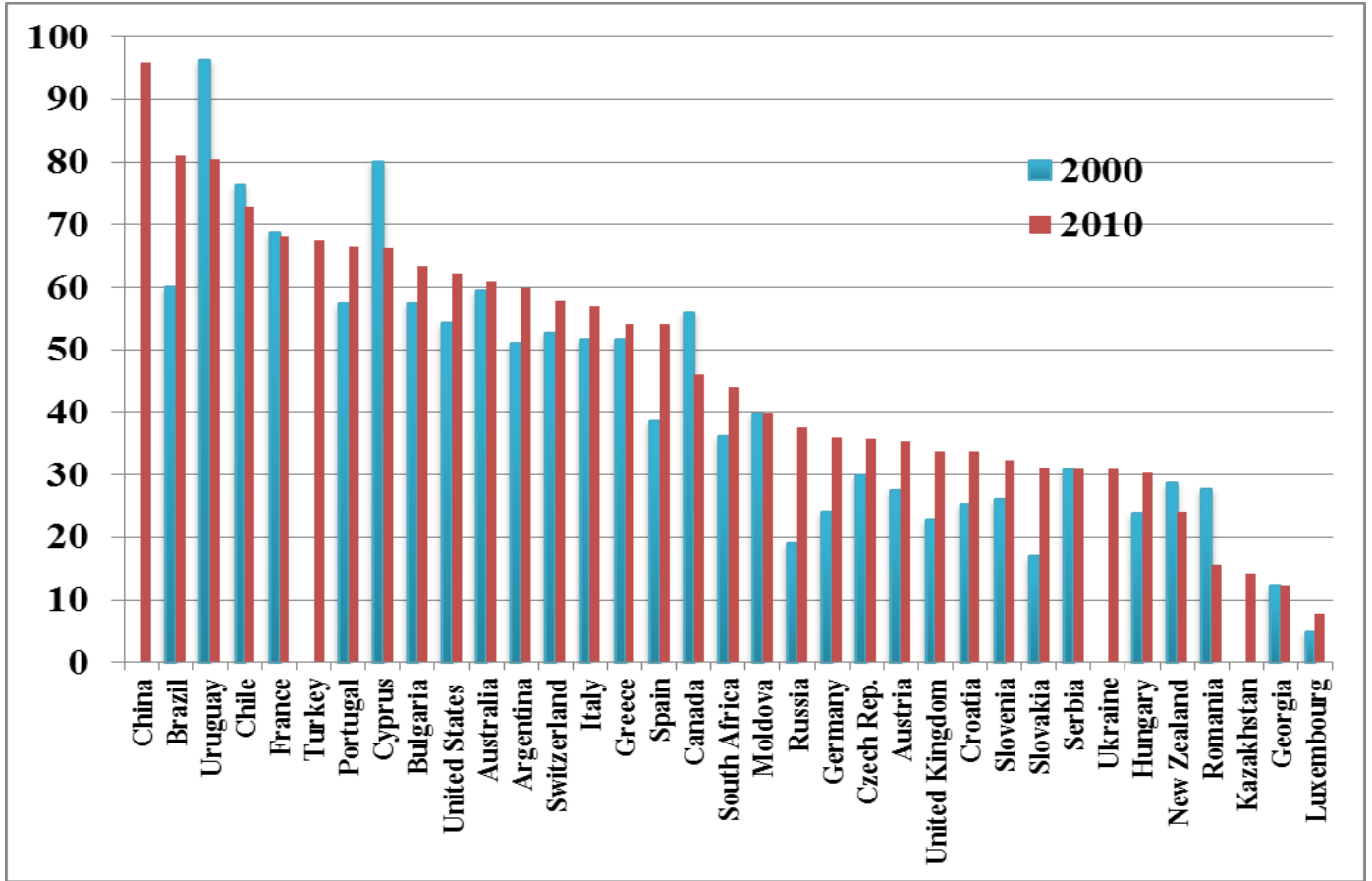


Figure 8: Index of Varietal Similarity of individual countries with the world, 2000 and 2010

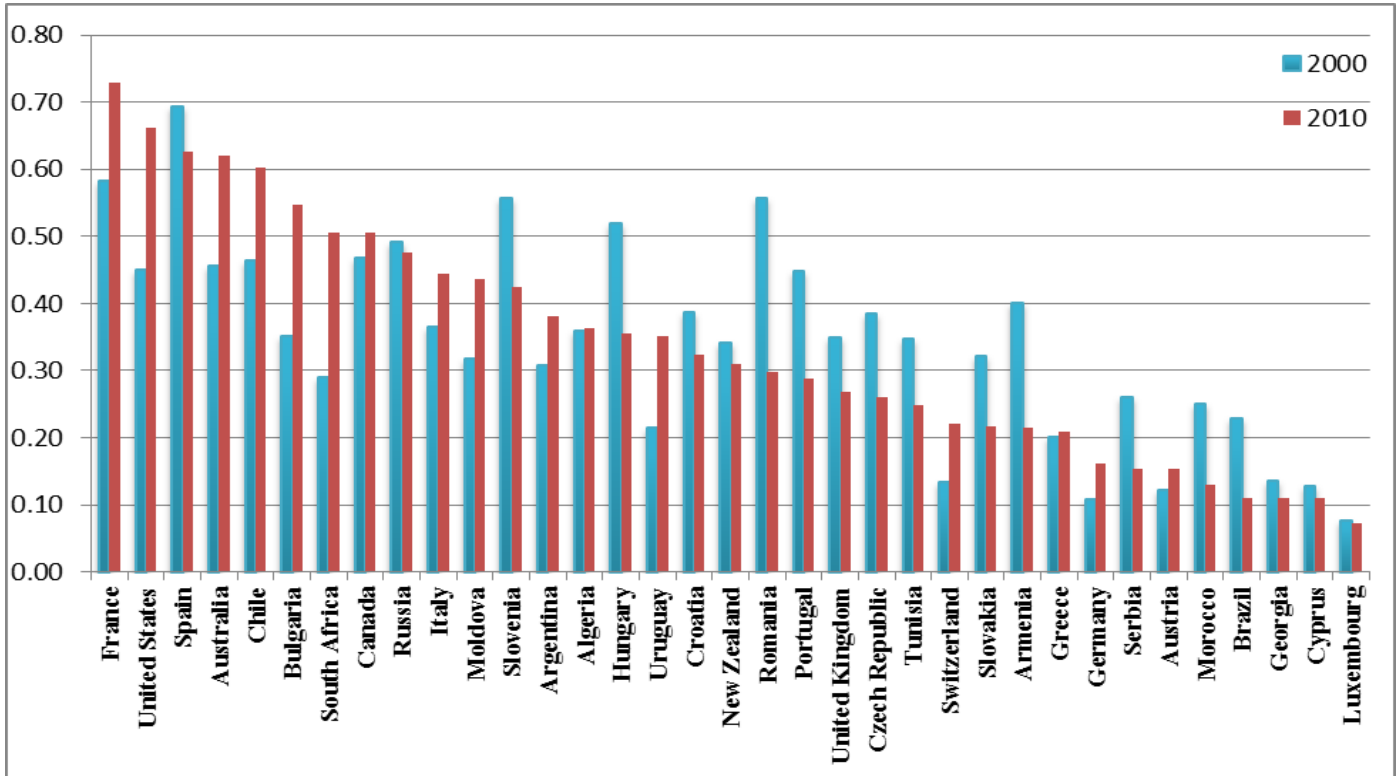


Figure 9: Index of Varietal Similarity between 2000 and 2010 for each country

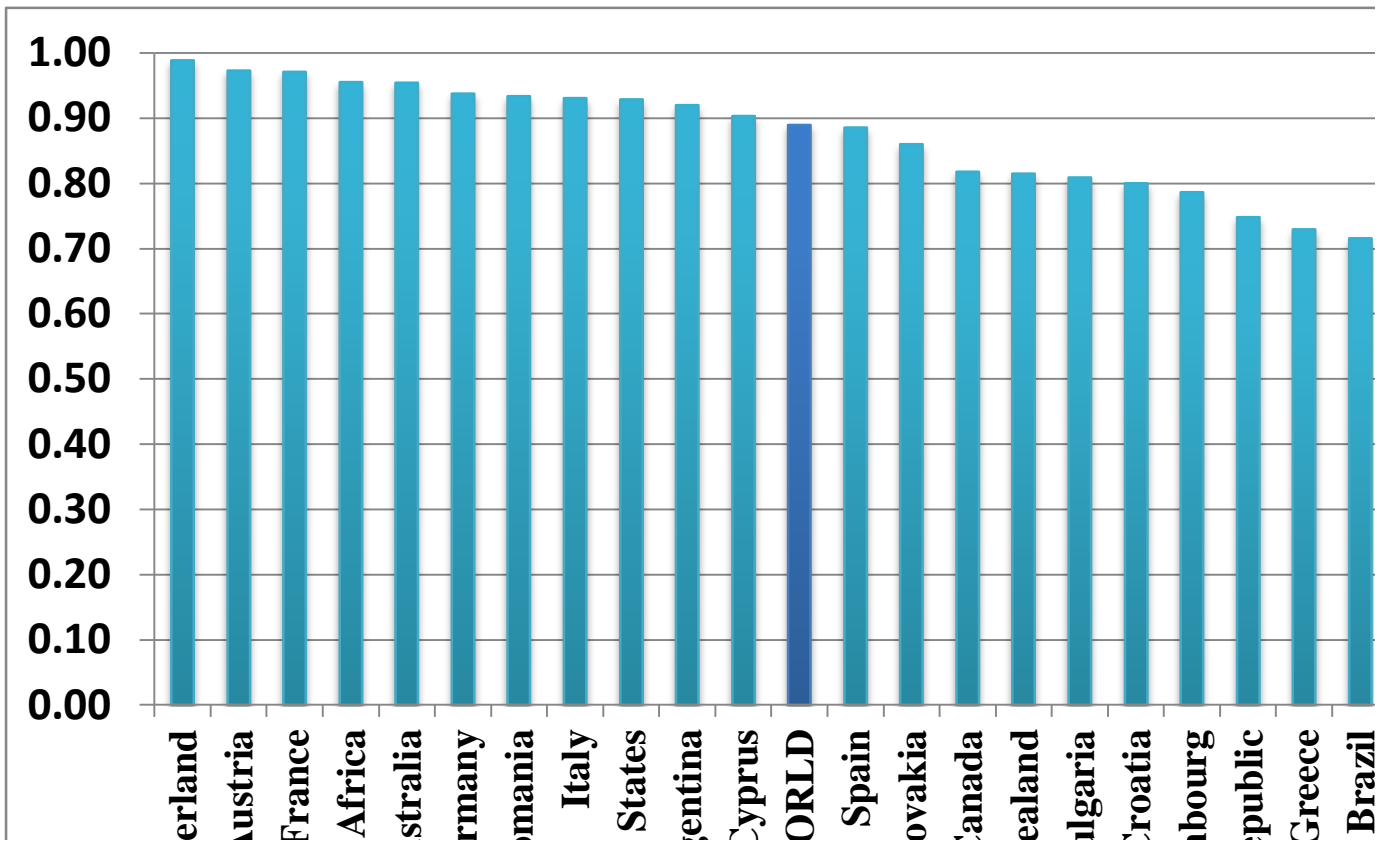


Figure 10: Index of Varietal Similarity of each country with the country with closest varietal mix, 2010

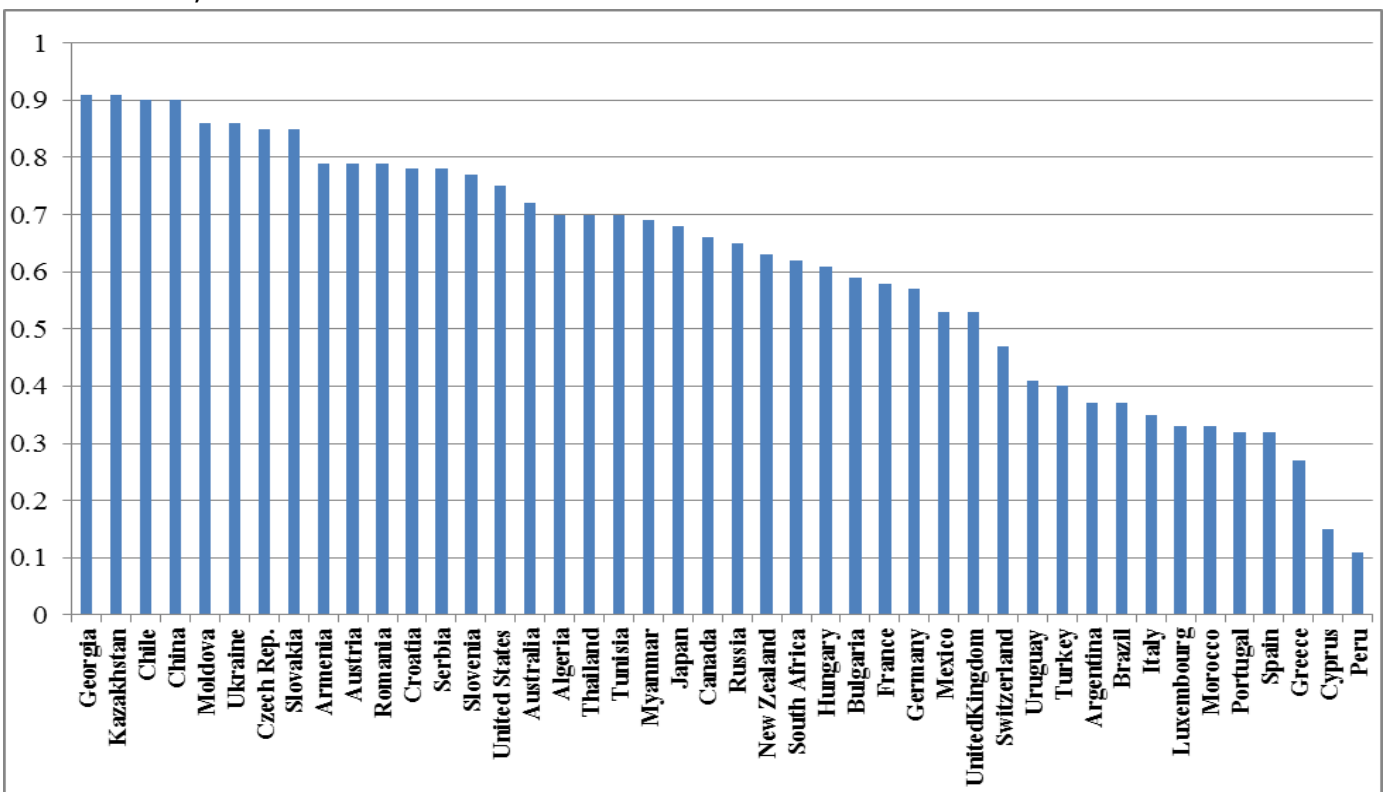


Table 1: Number of regions and prime varieties, by country, 2000 and 2010

<i>Country</i>	<i>Code</i>	<i>2000</i>		<i>2010</i>	
		<i>No. of regions</i>	<i>No. of varieties</i>	<i>No. of regions</i>	<i>No. of varieties</i>
Algeria	DZ	1	8	1	8
Argentina	AR	3	31	28	111
Armenia	AM	1	6	1	6
Australia	AU	76	43	94	40
Austria	AT	4	33	4	35
Brazil	BR	1	19	1	101
Bulgaria	BG	1	21	6	16
Canada	CA	1	20	2	76
Chile	CL	8	38	9	54
China	CN			10	17
Croatia	HR	1	7	13	72
Cyprus	CY	1	2	1	15
Czech Rep.	CZ	1	10	2	32
France	FR	29	285	45	96
Georgia	GE	1	21	1	21
Germany	DE	13	68	13	91
Greece	EL	13	60	13	56
Hungary	HU	1	32	22	137
Italy	IT	103	323	110	396
Japan	JP			5	15
Kazakhstan	KZ			6	15
Luxembourg	LU	1	11	1	10
Mexico	MX			5	17
Moldova	MD	1	39	1	39
Morocco	MA	1	8	1	8
Myanmar	MM			1	11
New Zealand	NZ	10	22	11	45
Peru	PE			4	30
Portugal	PT	9	80	9	266
Romania	RO	1	18	8	86
Russia	RU	1	11	2	55
Serbia	RS	1	4	1	4
Slovakia	SK	1	11	6	35
Slovenia	SI	1	6	10	21
South Africa	ZA	9	68	9	68
Spain	ES	36	159	36	150
Switzerland	CH	18	51	18	58
Thailand	TH			1	13
Tunisia	TN	1	9	1	9
Turkey	TR			7	35
Ukraine	UA			1	22
United Kingdom	UK	1	9	1	44
United States	US	61	84	89	129
Uruguay	UY	1	8	1	41
"Missing 9 in 2000" M9		1	101	na	na
Sample total		414	1018	611	1289

Table 2: National shares of global winegrape area and wine production volume, 2000 and 2010

<i>Sampled wine-producing countries</i>	<i>Share (%) of global area</i>		<i>Share (%) of global wine production</i>		<i>Non-sampled wine-producing countries</i>	<i>Share (%) of global wine prodn, 2010</i>
	2000	2010	2000	2010		
Spain	23.97	22.13	13.11	12.16	Macedonia	0.31
France	17.54	18.23	21.19	21.19	Belarus	0.08
Italy	12.91	13.47	19.72	16.31	Uzbekistan	0.08
United States	3.56	4.91	8.02	8.76	Albania	0.06
Argentina	4.08	4.33	5.00	5.03	Montenegro	0.06
Romania	4.51	3.67	1.95	1.46	Turkmenistan	0.06
Portugal	4.16	3.52	2.72	2.24	Lebanon	0.05
Australia	2.65	3.27	2.91	4.03	Cuba	0.04
Chile	2.31	2.40	2.02	3.40	Madagascar	0.03
Germany	2.11	2.20	3.93	2.86	Egypt	0.03
South Africa	1.90	2.17	2.62	3.40	Azerbaijan	0.03
Moldova	1.82	1.93	0.33	0.45	Bolivia	0.03
Hungary	1.76	1.50	1.34	0.90	Lithuania	0.02
Serbia	1.40	1.49	0.59	0.78	Israel	0.02
Bulgaria	1.95	1.21	0.62	0.56	Bosnia & Herz.	0.01
Greece	1.03	1.17	1.41	1.13	Belgium	0.01
Ukraine		1.13		0.93	Zimbabwe	0.01
Brazil	1.07	1.06	1.09	1.20	Malta	0.01
Morocco	1.01	1.05	0.14	0.11	Paraguay	0.01
Georgia	0.76	1.03	0.25	0.33	Latvia	0.01
Austria	0.98	0.98	0.90	0.72	Kyrgyzstan	0.01
New Zealand	0.20	0.69	0.21	0.65	Ethiopia	0.01
Algeria	0.61	0.65	0.15	0.19		
China		0.64		5.68		
Russia	1.14	0.55	0.99	2.24		
Croatia	1.21	0.45	0.70	0.18		
Tunisia	0.34	0.36	0.15	0.08		
Slovenia	0.48	0.35	0.14	0.09		
Czech Rep.	0.23	0.35	0.19	0.17		
Switzerland	0.31	0.32	0.45	0.38		
Turkey		0.28		0.09		
Slovakia	0.32	0.27	0.16	0.10		
Armenia	0.23	0.24	0.02	0.02		
Canada	0.17	0.22	0.17	0.19		
Cyprus	0.37	0.19	0.20	0.04		
Uruguay	0.18	0.16	0.34	0.22		
Kazakhstan		0.15		0.06		
Mexico		0.12		0.15		
Japan		0.08		0.26		
Peru		0.08		0.22		
Luxembourg	0.03	0.03	0.05	0.04		
United Kingdom	0.02	0.03	0.00	0.00		
Thailand		0.00		0.00		
Myanmar		0.00		0.00		
"Missing 9 in 2000"	1.63	n.a.	5.14	n.a.		
Rest of the world	1.06	0.96	1.06	0.96		
Sample total	98.94	99.04	98.94	99.04	Non-sample total	0.96

Table 3: National winegrape areas and change between 2000 and 2010

<i>Country</i>	<i>Area in 2000 (hectares)</i>	<i>Area in 2010 (hectares)</i>	<i>Changes in area (hectares)</i>	<i>Changes in %</i>
Algeria	30200	30200	0	0.0
Argentina	201113	201060	-54	0.0
Armenia	11206	11206	0	0.0
Australia	130602	151788	21,186	16.2
Austria	48496	45533	-2,963	-6.1
Brazil	52840	49412	-3,428	-6.5
Bulgaria	95997	56133	-39,864	-41.5
Canada	8498	10096	1,598	18.8
Chile	113966	111525	-2,441	-2.1
China		29545		
Croatia	59448	20754	-38,694	-65.1
Cyprus	18282	8608	-9,674	-52.9
Czech Rep.	11331	16242	4,911	43.3
France	864846	846880	-17,966	-2.1
Georgia	37419	48001	10,582	28.3
Germany	104233	102186	-2,047	-2.0
Greece	50878	54389	3,511	6.9
Hungary	86886	69715	-17,171	-19.8
Italy	636662	625700	-10,962	-1.7
Japan		3715		
Kazakhstan		6938		
Luxembourg	1348	1304	-44	-3.3
Mexico		5465		
Moldova	89844	89844	0	0.0
Morocco	49600	49000	-600	-1.2
Myanmar		75		
New Zealand	9942	31964	22,022	221.5
Peru		3831		
Portugal	205003	163522	-41,481	-20.2
Romania	222173	170292	-51,881	-23.4
Russia	56332	25628	-30,704	-54.5
Serbia	68999	68999	0	0.0
Slovakia	15580	12637	-2,944	-18.9
Slovenia	23472	16354	-7,118	-30.3
South Africa	93656	101016	7,361	7.9
Spain	1181805	1028258	-153,547	-13.0
Switzerland	15042	14820	-222	-1.5
Thailand		149		
Tunisia	16836	16836	0	0.0
Turkey		12856		
Ukraine		52293		
United Kingdom	873	1198	325	37.2
United States	175693	227948	52,255	29.7
Uruguay	8880	7657	-1,223	-13.8
"Missing 9 in 2000"	80221	(114867)	(34646)	(43.2)
Old World subtotal	3955626	3569091	-386,535	-9.8
New World subtotal	922575	1032480	109,905	11.9
World total	4878202	4601571	-276,630	-5.7

Table 4: Each country's six most-similar winegrape countries^a in the world according to the Varietal Similarity Index, 2010

Algeria	0.70	TN	0.55	FR	0.31	MX	0.20	TR	0.18	MM	0.18	US
Argentina	0.37	AU	0.36	CL	0.31	US	0.30	CN	0.29	ZA	0.27	FR
Armenia	0.79	RO	0.59	KZ	0.50	GE	0.32	SI	0.30	UA	0.26	HR
Australia	0.72	US	0.70	TH	0.67	CL	0.64	MM	0.62	ZA	0.58	FR
Austria	0.79	SK	0.71	CZ	0.43	HU	0.26	SI	0.26	HR	0.20	RS
Brazil	0.37	MD	0.14	UA	0.12	UY	0.08	RO	0.08	US	0.07	BG
Bulgaria	0.59	JP	0.56	CL	0.55	CN	0.54	US	0.49	MX	0.48	FR
Canada	0.66	US	0.54	JP	0.51	AU	0.49	FR	0.45	CL	0.45	UK
Chile	0.90	CN	0.75	US	0.67	AU	0.65	RU	0.58	ZA	0.57	JP
China	0.90	CL	0.59	RU	0.59	US	0.55	BG	0.53	MX	0.48	AU
Croatia	0.78	RS	0.77	SI	0.50	HU	0.50	SK	0.39	RO	0.39	CZ
Cyprus	0.15	MX	0.12	TN	0.10	FR	0.10	AU	0.10	CL	0.09	DZ
Czech Rep.	0.85	SK	0.71	AT	0.57	DE	0.56	HU	0.44	SI	0.39	HR
France	0.58	AU	0.57	US	0.55	DZ	0.52	JP	0.49	CA	0.49	CL
Georgia	0.91	KZ	0.63	UA	0.50	AM	0.38	MD	0.19	BG	0.13	RU
Germany	0.57	CZ	0.41	LU	0.39	CA	0.35	UK	0.33	CH	0.30	SK
Greece	0.27	BG	0.26	MA	0.24	MX	0.22	RO	0.21	SI	0.18	AM
Hungary	0.61	SK	0.58	SI	0.56	CZ	0.50	HR	0.43	AT	0.37	RS
Italy	0.35	FR	0.35	US	0.29	BG	0.28	JP	0.27	CA	0.25	AU
Japan	0.68	US	0.59	BG	0.57	CL	0.54	CA	0.52	FR	0.49	RU
Kazakhstan	0.91	GE	0.68	UA	0.59	AM	0.44	MD	0.21	BG	0.20	RO
Luxembourg	0.41	DE	0.33	CZ	0.2	SK	0.19	CA	0.12	HU	0.12	SI
Mexico	0.53	CN	0.51	CL	0.49	BG	0.43	FR	0.41	ZA	0.41	US
Moldova	0.86	UA	0.48	RU	0.44	US	0.44	KZ	0.43	CL	0.41	NZ
Morocco	0.33	TN	0.26	EL	0.21	BG	0.19	MX	0.17	DZ	0.14	SI
Myanmar	0.69	TH	0.64	AU	0.63	NZ	0.45	ZA	0.38	FR	0.32	TR
New Zealand	0.63	MM	0.41	MD	0.38	ZA	0.36	CL	0.36	CA	0.35	US
Peru	0.11	HU	0.07	SK	0.06	MX	0.05	CZ	0.05	SI	0.04	MM
Portugal	0.32	ES	0.14	MX	0.14	MM	0.13	TH	0.12	AU	0.10	AR
Romania	0.79	AM	0.46	SI	0.39	HR	0.35	RS	0.32	HU	0.30	BG
Russia	0.65	CL	0.59	US	0.59	CN	0.49	JP	0.48	MD	0.48	UA
Serbia	0.78	HR	0.60	SI	0.43	SK	0.37	HU	0.35	RO	0.27	CZ
Slovakia	0.85	CZ	0.79	AT	0.61	HU	0.50	HR	0.47	SI	0.43	RS
Slovenia	0.77	HR	0.60	RS	0.58	HU	0.47	SK	0.46	RO	0.44	CZ
South Africa	0.62	AU	0.60	US	0.58	CL	0.49	TH	0.47	FR	0.45	MM
Spain	0.32	PT	0.17	MX	0.16	FR	0.13	DZ	0.11	MM	0.10	AR
Switzerland	0.47	UK	0.30	CA	0.28	US	0.25	FR	0.24	NZ	0.23	MD
Thailand	0.70	AU	0.69	MM	0.49	ZA	0.36	TR	0.33	FR	0.24	AR
Tunisia	0.70	DZ	0.40	MX	0.36	FR	0.33	MA	0.17	EL	0.15	IT
Turkey	0.40	MX	0.39	AU	0.36	TH	0.32	MM	0.26	FR	0.23	ZA
Ukraine	0.86	MD	0.68	KZ	0.63	GE	0.48	RU	0.37	CL	0.36	BG
United Kingdom	0.53	US	0.47	CH	0.45	CA	0.34	AU	0.33	JP	0.31	NZ
United States	0.75	CL	0.72	AU	0.68	JP	0.66	CA	0.60	ZA	0.59	RU

Table 4 (continued): Each country's six most-similar winegrape countries^a in the world according to the Varietal Similarity Index, 2010

Uruguay	0.41	FR	0.36	BG	0.32	CL	0.31	JP	0.30	US	0.30	CN
Old World	0.74	ES	0.64	FR	0.46	BG	0.46	US	0.43	MX	0.43	IT
New World	0.87	US	0.87	CL	0.84	AU	0.72	ZA	0.70	CN	0.64	FR
World	0.72	FR	0.65	US	0.62	ES	0.62	AU	0.60	CL	0.55	BG

^a Country codes are Algeria(DZ), Argentina(AR), Armenia(AM), Australia(AU), Austria(AT), Brazil(BR), Bulgaria(BG), Canada(CA), Chile(CL), China(CN), Croatia(HR), Cyprus(CY), Czech Rep.(CZ), France(FR), Georgia(GE), Germany(DE), Greece(EL), Hungary(HU), Italy(IT), Japan(JP), Kazakhstan(KZ), Luxembourg(LU), Mexico(MX), Moldova(MD), Morocco(MA), Myanmar(MM), New Zealand(NZ), Peru(PE), Portugal(PT), Romania(RO), Russia(RU), Serbia(RS), Slovakia(SK), Slovenia(SI), South Africa(ZA), Spain(ES), Switzerland(CH), Thailand(TH), Tunisia(TN), Turkey(TR), Ukraine(UA), United Kingdom(UK), United States(US), and Uruguay(UY).