

Vienna 2019 Abstract Submission

Title

The diversification of grape varieties as a risk management tool in the vineyard

I want to submit an abstract for:

Conference Presentation

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Keywords

climate change, risk management, fine wine

Research Question

Is it possible for a winemaker to diversify by exploiting several grape varieties and thereby reduce the impact of climatic risk?

(See the attached PDF document for more details)

Methods

Multivariate regressions, portfolio diversification analysis

(See the attached PDF document for more details)

Results

We first document a strong relation between weather conditions and wine production. We then demonstrate that diversification may enable producers to substantially reduce variability in both quality and quantity produced.

Abstract

See the attached PDF document (it contains the abstract + two figures).

THE HARD REALITY

If the debate on the exact causes of climate change is not over yet, the reality of climate change is now fully recognized. Its effects are more and more felt, especially in the agricultural sector, which sees crops vary over time both in quantity and quality. As Prof. Alston noted in a seminar organized at Bordeaux Sciences Agro in May 2018, "we are now fighting more to maintain production than to increase it."

The manifestations of climate change are essentially twofold. On the one hand, climatic hazards are more and more marked with, for example, regular rainfall surpluses or deficits, often excessive heat or, more rarely, unusual

cold episodes. On the other hand, the frequency of climatic accidents increases. The risk of frost, hail, and disease or pest attack is thus increasing.

IMPACT ON THE VINE

The vine is particularly concerned by the climatic risk. Wine production requires special conditions over a long period of time. The vegetative cycle is spread between April and September in a series of stages, the most critical being flowering, fruit set, veraison and ripening which concludes with the harvest. Each step has its own sensitivity to climatic conditions. During flowering and fruit set in May and June, for example, it is essential that the weather be sunny and warm. During maturation, sun with a little rain and marked day-night temperature differences are welcome. Prof. Dubourdieu set out five cumulative criteria (based on the steps listed above) to determine the potential of a vintage. The last vintage he evaluated in Bordeaux, 2015, met all the criteria and could thus be considered great. Below, the link between weather conditions and variations in quantity and quality produced is illustrated on the basis of the last five vintages in the Valais region and, for comparison, in Bordeaux.

- 2013: spring was rotten, but then summer and late summer were beautiful. Thus, despite limited quantities, the quality was generally good in Valais with structured and lively wines. Bordeaux, on the other hand, could not enjoy the same conditions during the summer and the grape harvests were low in quantity and quality.
- 2014: a vintage characterized by unusual moisture that allowed the *Drosophila Suzukii* fly to proliferate. The quantities are correct but the quality is average in Valais. Bordeaux is doing better and the quality is generally good.
- 2015: the exceptionally hot and dry summer resulted in a very good quality vintage but the quantities are limited.
- 2016: the summer was slow to set but the vintage appears in the end as balanced and without major excess, and enough rain. The quality is good in Valais and excellent in Bordeaux, and the quantities are comfortable.
- 2017: it's the year of the freeze. The summer was then beautiful and warm, so the quality is good, but the quantities are limited or very limited depending on the appellation.

This rapid perspective shows that each year, or almost every year, faces more or less marked hazards that result in quality and / or quantity discrepancies compared to the historical norm. These differences, which are sometimes large and always unpredictable, represent a considerable source of risk for producers and the wine market in general. This uncertainty corresponds to a new standard. The question is therefore whether it is possible to reduce variability in quantity and quality between vintages and thus reduce this risk.

DIVERSIFYING TO REDUCE CLIMATE RISK?

This paper aims at examining the following question: is it possible for a winemaker to diversify by exploiting several grape varieties and thereby reduce the uncertainty as to the quality and quantity produced by its estate? This idea is based on two observations. First of all, Valais is characterized by a wide variety of grape varieties, both in white and red. The same situation is found in certain regions of Italy and Austria but more rarely in France where the AOC rules limit the varieties that can be used. In addition, by comparing the Valais grape varieties, it appears that they have their own specificities and do not all have the same sensitivity to climatic hazards. Thus some are earlier, or more resistant to disease, or naturally more consistent in terms of production.

Based on these observations, we analyzed, using data from the 2003 to 2017 vintages, whether exploiting a diversified portfolio of grape varieties, for both colors, reduces climate risk. The results, visible in the two figures in the attached PDF document, suggest that this is the case.

Figure 1 shows the relationship between the number of grape varieties harvested (horizontal axis) and the climatic risk that is captured by the standard deviation of the quantity produced relative to the norm over the period 2003-2017 (vertical axis). The solid line shows the mean standard deviation for all possible combinations involving 1 to 10 grape varieties. Thus, with only one varietal randomly selected, the standard deviation is 0.44, which means that there is about a one third probability for production on a given year to deviate by more than 44% from the norm. This figure shows that it is possible to reduce the risk by better choosing the grape used. Thus, the first blue circle on the left shows that by choosing Pinot Noir (which was the most constant grape variety over the 2003-2017 period), the standard deviation drops to 0.35. That's good, but an even more effective way to reduce the risk is to diversify.

Increasing the number of exploited grape varieties makes it possible to very significantly reduce the standard deviation. The figure shows that with four different varieties, it is possible, on average, to reduce by 40% the variability of the quantities produced. Indeed, the continuous line progressively increases from a value of 0.44 to 0.27 when we increase the number of varieties considered from 1 to 4. From eight grape varieties randomly selected, the risk is even halved compared to the initial situation. Note in passing that this figure makes no

particular assumption as to the weight to be allocated to the various grape varieties: in a portfolio composed of x grape varieties, each has a weight equivalent to $1/x$. The dashed line in the figure shows that it is possible to reduce even more strongly the risk if the grape varieties are chosen with particular care: just combining four white and red, late and early varieties, such as Chasselas, Petite Arvine, Pinot noir and Sylvaner, can reduce the climate risk by almost two-thirds.

Figure 2 is similar in construction but focuses on the variation in Oechsle degrees that we consider as a variable measuring quality. Certainly other dimensions come into play to define a great wine. But to make a good wine, you must first harvest grapes at maturity and therefore with enough sugar. The figure also shows that it is possible to reduce the risk of suffering from a lack of maturity, or on the contrary of excessive maturity, by working with multiple grape varieties. The results are very similar to those in Figure 1, except that the vertical axis contains much lower values. This shows that the variations in degrees Oechsle are smaller than those in quantity. This is explained by the fact that it is always possible to modulate the dates of harvest to return grapes with a satisfactory degree of maturity.

VALAIS: AN EXAMPLE TO STUDY AND FOLLOW?

The results presented and analyzed above are clear. In the short term, wine growers can reduce uncertainty about the quantity and quality of the grape harvest by diversifying and therefore by exploiting multiple grape varieties. Such a reduction in risk makes it possible to increase visibility and is therefore very useful, especially for small family structures. In the medium / long-term, such a diversification also represents a source of strategic flexibility, it increases the capacity of adaptation, and allows the development of competences (work on various varieties of different colors and thus various types of wines). In short, the benefits certainly exceed the costs of additional complexity.

In the case of Valais and more generally Switzerland, the presence of multiple grape varieties can be explained by local and historical specificities (responding to local demand, customs duties) and a panorama of different terroirs (adoption under conditions). But the fact remains that the country is ahead of others and could therefore serve as an example.

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The diversification of grape varieties as a risk management tool in the vineyard

December 2018

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¹ The flower begins to develop a seed and grape berry.

² The grape berries which were green start to change color.

³ Prof. Dubourdieu taught at the Institut des Sciences de la Vigne et du Vin (ISVV, University of Bordeaux). He passed away in 2016.

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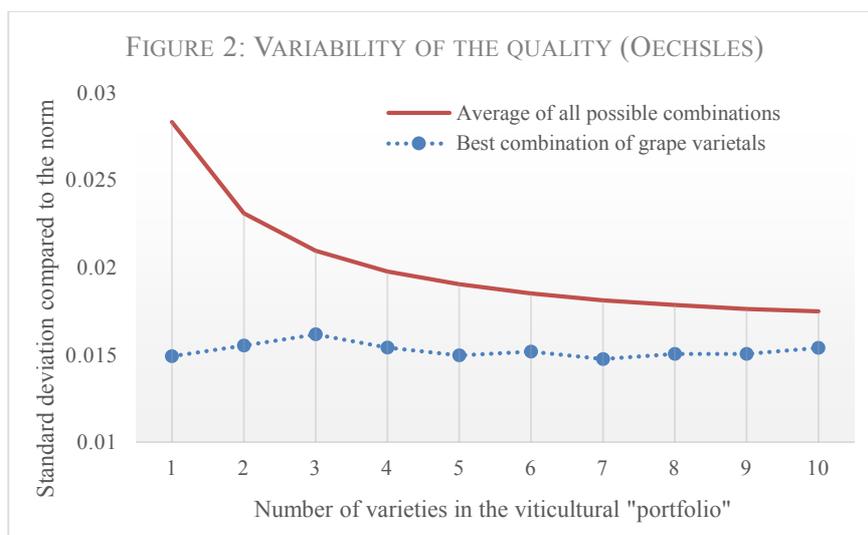
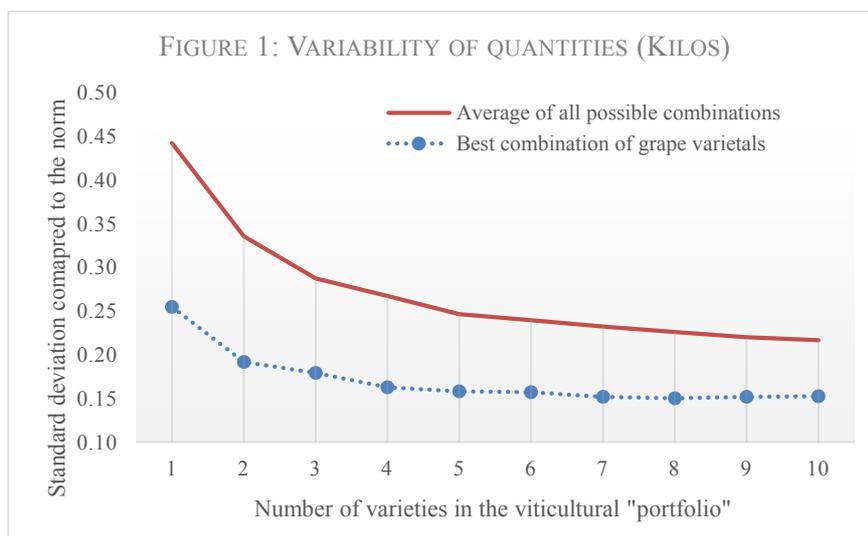
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⁴ In the case of a normal distribution, two thirds of observations lie between a +1 and -1 standard deviation around the mean (norm).

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