Wine in the blood?

Explaining French Wine Exports: Gravity, Preferences and Genetics

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Abstract

Standard determinants of trade hide frictions that seem more important than distance or border effects. These dark trade costs are very likely explained by culture and preference heterogeneity as shaped by history. We provide new evidence along these lines by estimating trade determinants for a good that is globally consumed and may effectively appeal to taste diversity: French wine. This good is all the more interesting as the great diversity of French wine production, from low quality to fine wines, may help to test whether gravity-laws of trade apply uniformly or are altered for high-end products in this industry. For this investigation, we exploit a unique dataset on wine shipments in volume of almost 160 different types of French wines to the 27 main importing countries between 1998 and 2015. We estimate a gravity model that incorporates standard determinants of exports (GDP, exchange rates, trade costs, multilateral resistance), expert-rated quality and top income share. In addition, we test the role of genetic distance as a measure of biological and cultural preference diversity. We first find that while standard determinants have the expected effect, genetic distance has a significant impact on trade, even after controlling for distance and microgeography. We also show that high-end wine products defy gravity. Expensive wines (using quantiles of unit values) are less affected by geographic distance than other wines – and not affected at all in the case of luxury wines from Champagne, Bordeaux and Bourgogne. However, even fine wines are subject to frictions pertaining to preference and cultural differences.

JEL Classifications: wine exports, cultural/genetic distance, geographical distance, gravity model, PPML

Keywords: F10, F14, L66, Q17

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1. Introduction

The literature on trade determinants has recently pointed out the role of hidden sources of resistance to trade (Head and Mayer, 2013). These “dark trade costs” have been detected in the estimation of standard gravity models as explaining a large share of the coefficients on borders and distance effects. Indeed, according to Grossman (1998) and Head and Mayer (2013), these coefficients are usually too large to be explained by traditional tariffs or transportation costs related to border, freight costs or the geography.[4] Therefore, opening the “blackbox” of the usual gravity determinants of trade is an important agenda, which necessarily faces the difficult to identify, interpret and measure dark costs accurately. As suggested by Head and Mayer (2013), these sources of frictions could be linked to cultural differences and localized tastes inherited from the past (diversifying factors include human migration, natural decay of information across space, colonial legacies, the long-run impacts of conflicts, etc.). While freight costs have declined thanks to innovation, trade costs may be persistent if such hidden frictions are large and subject to slow changes in culture and preferences.

In the present paper, we address this question while exploring the trade determinants of a good that is both globally consumed and precisely linked to local preferences and culture: wine. Wine is now widely available and wine drinking has become common in Western countries, in Japan, Russia, China and some South American countries like Brazil. The consumption dynamics and the wine industry globalization have evolved relatively fast with the democratization of wine consumption and the existence of new wine consuming countries, increased competition and the emergence of new producers and exporters, notably “new world” wines (Anderson et al., 2003, Anderson and Nelge, 2011). As a cultural good, wine is a perfect candidate for the exploration of dark trade costs related to preference and cultural diversity shaped by history. This aspect, and more generally the question of trade determinants, is all the more interesting as we focus on French wine. Not only are French wines globally renowned, but they also represent a large market share (France remains the world’s leading exporter in value and is now the third in volume) and a great diversity. Indeed, while French wine used to be a luxury good, the structure of its exports has changed and includes a great variety of types and qualities for different types of consumers all over the world.

To investigate trade determinants and elicit the role of dark trade costs, we exploit a unique dataset recently assembled by the “French federation of exporters of wine and spirit” on wine shipments in volume and value terms. Representing 95 % of total French exports of wine, it includes the exports of almost 160 different types of French wines to 27 countries between 1998 and 2015. We combine this data with information on standard trade determinants (GDP,

[4] For instance, Head and Mayer suggest that dark trade costs would account for 50%-85% of the negative effect of geographical distance on trade flows, in their estimation based on the data of Feyrer (2009).

real exchange rates, geographic distance), multilateral resistance, quality as proxied by expert wine scores, importing countries' own wine production, and income inequality. This very comprehensive dataset is used to estimate a gravity model to disentangle the determinants of wine exports. We use state-of-the-art modelling with a gravity model *à la* Anderson and Van Wincoop (2003, 2004) estimated by Poisson pseudo-maximum likelihood following Santos Silva and Tenreyro (2006) in order to account for heteroskedasticity and the presence of zero trade flows. Then, our main contribution pertains to the exploration of dark trade costs. We question how French wine exports respond to genetic distance, which may directly capture biological preference heterogeneity, as shaped by the genetic history of nations, and indirectly proxy cultural differences. Finally, we wonder whether a cultural good like wine follow the usual regularities found in the literature on exports, in general and when examining export flows by reputation, quality or price level. Having a high diversity of wines in our database – all wine color (red, white, sparkling), all French regions, and wines with and without mention of origin, including fine wines from *appellations communales* – also allows us to study exports by quality level.

We obtain three main results. First, while standard determinants (like GDP, GDP per capita and exchange rates) have the expected effect, we find that genetic distance has a significant impact even when controlling for geographical distance. Contrary to Giuliano et al. (2014), we also find a persistent effect after controlling for additional microgeographic factors (such as transportation costs or ruggedness). We interpret the genetic effect as biological and cultural diversity in tastes across countries. Then, it turns out that high-end wine products defy gravity. Simply looking at famous regions (Bordeaux and Bourgogne) versus the rest of France shows that distance plays less of an effect on wines from the former groups. More specifically, luxury wines defined as the upper tercile of unit values are less affected by geographic distance than other wines – and not affected at all in the case of luxury wines from Champagne, Bordeaux and Bourgogne. These results are in line with Fontagné and Hatte (2013) and Martin and Mayneris (2015) on French luxury brands and the study of Crozet et al. (2012) on champagne producers. However, we find that luxury wine exports are still affected by genetic distance, even when controlling for geographical factors. That is, cultural and tastes differences represent an important source of trade resistance even for luxury goods.

The paper is structured as follows. Section 2 presents the literature. In section 3, we describe the data at use and sketch the trends in French wine exports over the past two decades, both at the extensive and intensive margins. Section 4 briefly explains modelling choices, i.e. the gravity model and estimation methods. Section 5 presents and discussed the results and robustness checks. Section 6 concludes.

2. Literature

2.1 Trade determinants

The international trade literature (for instance Armington, 1969; Warner and Kreinin, 1983) usually highlights foreign demand (determined by country income and tastes) and price-competitiveness (determined by relative prices and nominal exchange rates) as key determinants of exports.

The more recent literature adds non-price competitiveness and particularly the quality of goods (Hallak, 2006) as well as trade costs and frictions, which include transportation cost, tariffs and non-tariffs barriers. In fact, both aspects are related, since the capacity of firms to bear trade costs is highly correlated to the quality of their products. Indeed, Fontagné and Hatte (2013) and Martin and Mayneris (2016) show that high-end exporters are less sensitive to distance (which is a proxy for trade costs) than low-end exporters. They are also more sensitive to average income and income distribution in the destination country. These aspects are potentially important when studying luxury wines. As in these studies, we will check the role of distance on high-end wine by interacting distance with quantiles of unit values in our estimation – our data also allows more qualitative variants as we can interact distance with types of wines according to their reputations

Finally, Head and Mayer (2013) argue that behind the estimated coefficient associated with distance or to the border effect in the standard gravity model of trade, hidden sources of resistance are of greater importance. These dark trade costs (for the analogy to astrophysics) would account for 50%–85% of the effect of distance on trade flows, according to their estimation based on the data of Feyrer (2009). These “new” sources of frictions could be linked to spatial decay of information, localized tastes, colonial legacies, and long-run impacts of conflict. To the extent that taste and cultural discrepancies between countries enter this definition, it seems interesting to account for some sort of proxy for cultural/preference proximity to French consumers (who consume almost exclusively French wine!) in our estimations. For that, we shall use genetic distance, taken as a proxy for cultural and preferences distance.

The role of genetics in explaining the taste preferences has been highlighted for years in the biological field. In a review of the biological literature, Reed et al. (2006) displayed what are the genes and the molecular receptors responsible for taste preferences. In another review, Birch (1999) reveals how the interaction between environmental factors (culture) and the genetic predispositions produces food preferences. These genetics-based preferences have been analyzed in the context of different ethnic groups and nationalities, showing significant differences in food tastes in general (Bertino and Chan, 1986; Pirastu et al., 2012) and in alcoholic beverages in particular (Duffy et al., 2004, Lanier et al., 2005). Genetics also matters in the context of wine preferences. In particular, Pirastu et al. (2015) reveal the genes responsible for white or red wine preferences on a large sample of three different populations from Italy, Central Asia and Netherlands. Another strand of the literature in the economics and marketing field also exhibits national's related preferences for different types of wines (Cardebat and Livat, 2016) and different cultural approaches in the wine consumption (Somogyi et al., 2011). All in all, the hypothesis of wine preferences based on culture and genetics has received a strong support in the literature. The genetic distance between populations appears in this context as a consistent proxy capturing national differences in preferences.

2.2 Global wine trade

Several studies look at wine exports in the world and highlight the role of usual determinants like trade costs and frictions, real exchange rates or quality. Anderson and Wittwer (2001 and 2013) use a computable general equilibrium model to assess the impact of changes in world demand and real exchange rate on wine exports, showing in particular that real exchange rates have played in favor of the US and the EU against New World wine-exporting countries between 2007 and 2011 (especially against Australia). Several other studies highlight the significant impact of the exchange rates on the wine international trade. Cardebat and Figuet (2017) estimate an Armington model on a smaller version of the data we use in order to investigate the role of exchange rates on French wine exports and show the different strategies used by the exporters facing a Euro appreciation. Robinson (2009) analyzes exchange rate pass-through in the US market for imported wines. Anderson (2015) highlights the role of export determinants like the rise of the Australian dollar, increased competition from other wine-exporting countries and China's austerity policies (which have reduced demand for luxury wine products) as part of the explanation for the recent collapse of the Australian wine industry. Chen and Juvenal (2016) analyzes the heterogeneous response of exporters to changes in real exchange rates due to differences in product quality, both theoretically and empirically using Argentinean firm-level wine export values and volumes for 2002-2009 combined with experts wine ratings to measure quality.

The other determinants of trade also play an important role in the international wine trade flows. Dal Bianco et al. (2015) investigates the impact of trade barriers on the world wine trade using data from the main importing and exporting countries for 1997–2010. They find that frictions have a stable role over this period, technical barriers have a varying impact on trade while sanitary and phytosanitary standards do not obstruct wine trade. Kashiha et al. (2016) examines shipments of wine from European producers to 16 European ports and find a significant border effect, even within the European free-trade zone. Fleming et al. (2009) estimate a gravity model using data on the major wine trading countries over 1995-2008 to check the role of modern information and communication technologies, finding a modest effect. Carcillo et al. (2016) analyze the determinants and evolution of the global wine export dynamics and show that higher incomes, lower prices, cultural and geographical affinities, and trade agreements promote wine exports. Dascal et al. (2002) estimate a gravity model to analyze wine trade flows in twelve EU countries over 1989–97, highlighting the role of GDP per capita, remoteness, the depreciation of EU currencies and EU integration[5]. Candau et al. (2017) analyze the determinants of demand using bilateral export prices for French producers selling to all importers worldwide over 2001–11[6].

A few studies have focused on the quality determinants of trade, especially in the French case. Bouët et al. (2017) analyze the determinants of Cognac exports. Given the high-end nature of this brandy, this will serve as an interesting comparison point when we look at luxury wines - so do studies on French luxury brands such as Fontagné and Hatte (2013) and Martin and Mayneris (2015). Crozet et al. (2012) study the export of champagne producers and highlight the crucial role of quality. They assume that this industry conforms well to the assumption of heterogeneous firm monopolistic competition of Melitz (2003)'s model and focus on the quality interpretation of the latter. They suggest better proxies for quality than the unit value, i.e. they match firm-level export data with expert assessments of the quality of Champagne producers.

3. Data and stylized facts

3.1 Main data source

We exploit a dataset recently assembled by the "French federation of exporters of wine and spirit" (*Fédération des exportateurs de vins et spiritueux*) on wine shipments in volume and value terms. Representing 95 % of total French exports of wine, it includes the exports of 158 different types of French wines to 27 countries between 1998 and 2015. We shall focus on bottled wine for 158 wine designations of different categories of wine (white, red and rosé, sparkling wine).

We combine this data with other sources on standard trade determinants. For standard gravity variables (geographic distance, common language, etc.) we use the database provided by the Centre d'Etudes Prospectives et d'Information Internationales (CEPII). Data on GDP, per capita GDP in current dollars, bilateral exchange rates and Consumer Price Indexes (CPI) are from the World Bank's *World Development Indicators*. Bilateral exchange rates are expressed in real terms using the French and foreign country's CPI.

[5] Note also that Raimondi and Olper (2011) look more generally at the world trade of food and wine and the determinants related to trade costs/tariffs and tastes. Fogarty (2010) provides a rich survey on the evolution of the demand for wine and other alcoholic beverages. Finally, some papers also exist in the business and management literature on export performance (see for example, Maurel, 2009; Silverman et al., 2004), focused on firm determinants rather than economic determinants like exchange rate or foreign income.

[6] They distinguish in a panel structure the price levels specific to an importer-product (taste, culture, etc.) and an exporter-product (quality, etc.); among other results, they find that the price elasticity of demand is influenced by GDP per capita as well as importer GDP, contrasting with standard results based on monopolistic competition with homothetic preferences.

Data concerning ruggedness are taken from Nunn and Puga (2012)[7]. As Giuliano et al. (2014), we also construct two other variables to account for geographical barriers in Europe: one identifying major mountains chain between countries and the other assessing if France and its partners are sharing the same sea or ocean.

Finally, data on genetic distance come from the new database provided by Spolaore and Wacziarg (2016). In this paper, we only rely on the new weighted "coancestor coefficients", F_{ST}[8] based on differences in allele frequencies[9].

3.2 Main statistics on wine exports

International background. In recent decades, New World wine exports have increased fast at the expense of traditional wine producing countries. Europe still remains market leader on world wine market, with a concentrated production of global wine market characterized by the prominent role of France, Italy and Spain, which account for about 50 % of world wine production. French wine exports have declined in volume since the early 2000s, but not in value. Both volume and value of French wine exports have recorded a huge decrease after the 2007 financial crisis, before a recovery since 2009. From a leading position in export volumes (with a total export market share of 25%), France is now behind Italy and Spain (with only 15% of total exports). It remains leader in terms of export value.

Time changes and export destinations. In Figures 1 and 2, we present the evolution of French wine exports by broad destination regions, in value and in volume respectively. In a context of slight decreasing domestic production[10], exports to EU countries have dramatically decline in volume but not in value, showing a rapid change in consumers' taste in Europe toward lower and better wine consumption, with huge move toward beer in all the wine-consuming countries. We also notice a very strong increase in volumes of export towards Asian countries and an increase the value of exports towards both Asia and North America. It is interesting to note a huge increase of French wine exports towards China. Indeed, in 2005, Chinese imports represented less than 1% of French value and volume of wine exports. However, between 2005 and 2015, exports to China have been multiplied by 40 in volume and 35 in value with an annual average growth of 50 % (both in volume and value), whereas only exports flows to other Asian economies which have only been multiplied by 2 in value with an annual average growth of 9 %. As shown by Colen and Swinnen (2016), these changes in consumption trends denote a long term convergence in the worldwide drinking behavior.

[7] Data are freely available at http://diegopuga.org/data/rugged/#grid.
[8] Introduced by Cavalli-Sforza et al. (1994).
[9] Data are freely available at http://www.anderson.ucla.edu/faculty_pages/romain.wacziarg/papersum.html.
[10] See International Organisation of Vine and Wine (OIV, http://www.oiv.int/en/).

Figure 1 : Evolution of exports since 1998 (value)

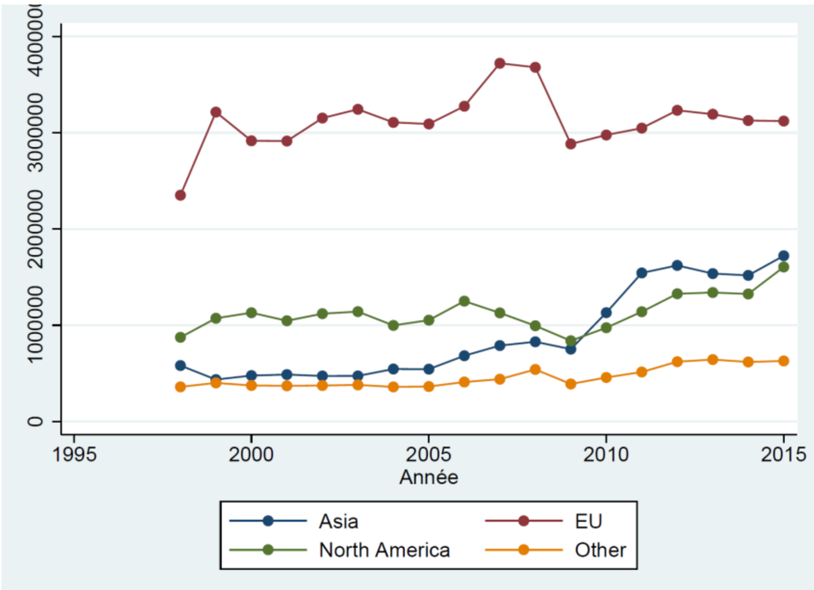


Figure 2 : Evolution of exports since 1998 (volume)

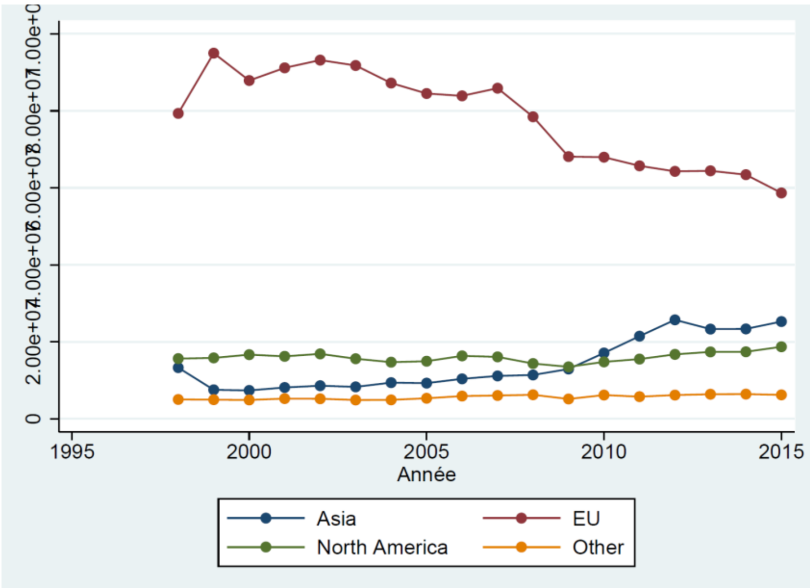
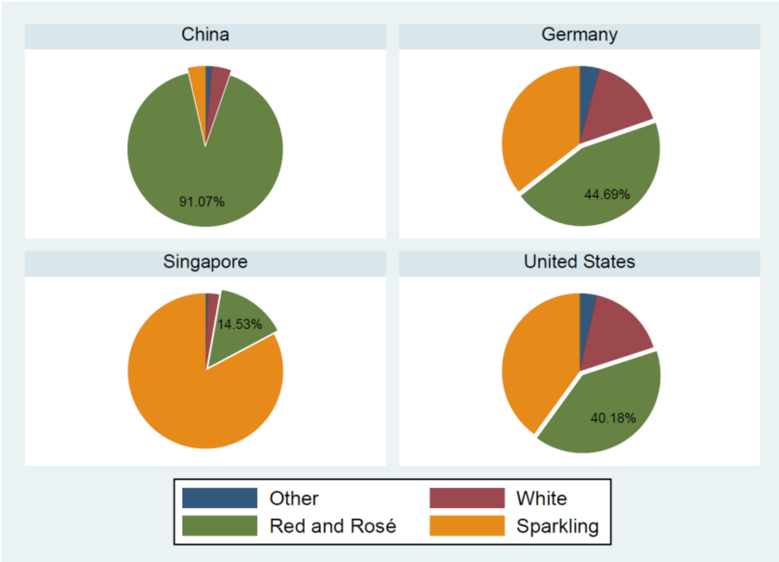


Figure 3 illustrates the diversity of export composition for two large importers among Western nations (the US and Germany) and for two Asian importers with different types of wine demand (China and Singapore) in 2015. This Figure gives us a clear picture of preference discrepancies across these countries. We can remark a strong preference for Red and Rosé in China, especially Bordeaux (29 %) and Médoc (9 %), while Singapore's market is focused on Champagne. In both cases, the exported wines are expensive (high-end). On the contrary, Germany and the U.S. displays more balanced preferences with around 40 % of total French wine imports related with Red and Rosé. However, it is important to note that if the U.S. and Germany seem to have similar tastes at first look, there exists strong differences among the different appellations imported. For instance, in terms of volume, the U.S. import more

Provence rosé, whereas Germany importing more *Vins IGP à pays d'OC*. Furthermore, some differences exist in terms of price unit. The U.S. consumers use to buy expensive wines (high-end) compared to German consumers buying less expensive wines (middle and low-end). These four cases are good examples of vertical and horizontal differentiation in the wine market.

Figure 3: Composition of imports in 2015



3.2 Trade, genetics and culture

One of the original determinants of wine exports we shall use is genetic distance. We rely on the impressive database on genetic distances among various populations collected by Spolaore and Wacziarg (2016). Contrary to Guiliano et al. (2014), we use the new measure of genetic distance provided by Spolaore and Wacziarg (2009, 2016).

This new measure is based on the data from Pemberton et al. (2013) rather than those from Cavalli-Sforza et al. (1994). The two databases differ not only on the method to identify relatedness in populations, classic genetic markets for Cavalli-Sforza et al. (1994) and microsatellites for Pemberton et al. (2013), but also in the coverage and specificity of populations. Indeed, the data provided by Pemberton et al. (2013) allow more detailed information on population, especially on Asian countries. They provide a new dataset on 645 common microsatellite loci for 5435 individuals from 267 worldwide populations, that comes from the combination of eight previous population-genetic datasets with a procedure to ensure comparability across populations and samples. As Cavalli-Sforza et al. (1994), they define the genetic distance measure, F_{ST}, at the population level. Spolaore and Wacziarg (2016) match populations to countries, relying on ethnic composition by country from Alesina et al. (2003) and provide a comprehensive dataset for genetic distance at the country level. In this paper, we rely mostly on the measure of weighted genetic distance that they provide in their dataset. Let $i = 1, \dots, N$, be the populations of country 1, $j = 1, \dots, L$ those of country 2,

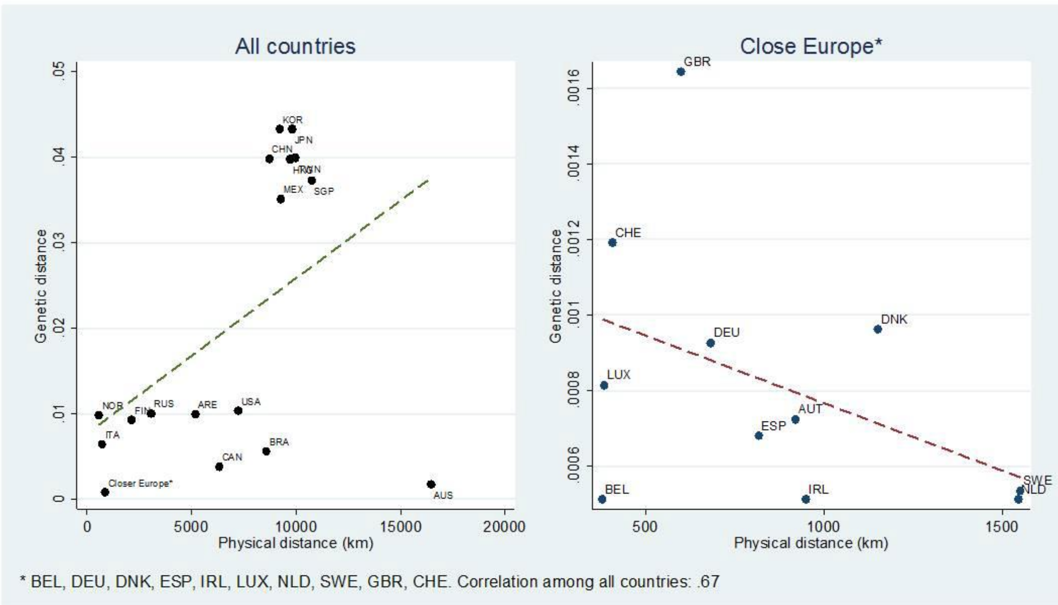
s_{1i} the share of population *I* in country 1 and $GenDist_{ij}$ the genetic distance between populations *I* and *j*. The weighted F_{ST} genetic distance between the two countries could be expressed as (Spolaore and Wacziarg, 2016):

$$F_{ST}^{W} = \sum_{i=1}^{N} \sum_{j=1}^{L} [s_{1i}\, s_{2j}\, GenDist_{ij}]$$

As a consequence, this measure could be assimilated as the expected genetic distance between two randomly selected individuals, one from each country (Spolaore and Wacziarg, 2016). A higher F_{ST}^{W} is associated with larger differences.

Looking at a single exporter – France – as we do may seem to limit the variation in genetic distance and lead to strong collinearity with geographical distance. In fact, the correlation is "only" 0.67. Most importantly, Figure 4 shows that this positive correlation is mainly due to Asian countries whose genetics are the farthest from French among importing countries and which also happen to be far away (left-hand-side graph). Interestingly, when we focus on European countries (right-hand-side graph), the correlation is actually negative (and small: -0.43). Hence, our favorite specification of the trade model will simply control for an "Asian countries" dummy when introducing genetic distance.

Figure 4: Genetic and physical distances



4. Gravity model and estimation methods

4.1 Theoretical foundations and gravity model

For the purpose of this paper, we rely on the standard gravity model of trade. In its first general formulation, this model states that bilateral trade flows depend positively on countries' gross domestic product (GDP) and negatively on distance. Since the first empirical application to trade provided by Tinbergen (1962), the theoretical foundations of this model have been well documented in the literature (see Anderson, 1979; Bergstrand, 1985; Anderson and Van Wincoop, 2003; Chaney, 2008)[11].

For instance, Anderson and Van Wincoop derive a structural gravity equation from a theoretical model based on CES demand function, homothetic preferences, monopolistic competition and Armington's (1969) hypothesis of product differentiation. They emphasize the key role lead by multilateral resistance, i.e. the trade barrier of a country relative to the average trade barrier of each country with all its partners, in determining trade flows. Fieler (2011) extends the model to non-homothetic preferences and stress the importance of income differences, i.e. per capita GDP, in the gravity model of trade, revealing that the volume of trade will be higher between rich economies. As a consequence, the algebraic formulation of the gravity equation that we use could be expressed as:

$$E\left(T_{ij}|Y_i, Y_j, \frac{Y_i}{L_i}, \frac{Y_j}{L_j}, D_{ij}, \tau_{ij}, P_i, P_j\right) = \gamma_0 Y_i^{\gamma_1} Y_j^{\gamma_2} \left(\frac{Y_i}{L_i}\right)^{\gamma_3} \left(\frac{Y_j}{L_j}\right)^{\gamma_4} D_{ij}^{\gamma_5}, \tau_{ij}^{\gamma_6}\, P_i^{\gamma_7} P_j^{\gamma_8}$$

Where T_{ij} represents trade flows between *i* and *j*, Y_i and , Y_j are the GDPs of countries *i* and *j*, L_i and , L_j are the populations in *i* and *j*, D_{ij} is the bilateral distance between *i* and *j*, τ_{ij} represents other trade frictions that affect trade, P_i and , P_j are price indices and γ_1, $\gamma_2, \gamma_3, \gamma_4, \gamma_5, \gamma_6, \gamma_7$ and γ_8 are the parameters to be estimated.

One of the main issue when implementing a gravity model of trade is related to the estimation of the two price indices. Indeed, the omission of any form of multilateral resistance in the gravity model would result in biased estimates. This is what Baldwin and Taglioni (2006) called the "gold medal mistake". In short-time span, Baldwin and Taglioni (2006) advise to include both importer and exporter fixed effects in the equation, as multilateral resistance change slowly over time. However, the focus of this paper is related to time invariant variables such as geographical and genetic distances. Thus, including importer fixed effects is not a valid solution to account for multilateral resistance as it captures all time invariant variables. One solution to deal with this problem is to rely on a remoteness indicator as presented in Head and Mayer (2014). This index is computed as follows, for each importer of French wines:

$$REM_j = \left[\sum_{i \neq j} Y_i D_{ij}^{-1}\right]^{-1}$$

This indicator is closely linked to the one proposed by Baldwin and Harrigan (2011), which is theoretically founded, but does not include within-country distance.

The most frequent approach developed in the empirical literature is to log-linearized the

[11] See Head and Mayer (2014) for a survey on the gravity model of trade.

gravity model of trade. In our case, we obtain an augmented gravity equation:

$$X_{Fjkt} = \gamma_0 + \gamma_2 \ln(Y_{jt}) + \gamma_4 ln\left(\frac{Y_{jt}}{L_{jt}}\right) + \gamma_5 \ln(D_{Fj}) + \gamma_6 \ln(Gdist_{Fj}) + \gamma_7 REM_j + \gamma_8 \ln(RER_{Fjt}) + \gamma_9 \ln(Prod_{kt}) + \gamma_{10} b_{Fj} + \delta Geo_{Fj} + \lambda_t + \lambda_k + \varepsilon_{Fjkt}$$

Where X_{Fjkt} represents French exports of appellation k to partner j at time t, $Gdist_{Fj}$ is the genetic distance between France and country j, RER_{Fjt} is the bilateral exchange rate between French currency and country j at time t, $Prod_{kt}$ si the volume of wine production in country j, b_{Fj} is a dummy variable that capture the existence of a common border, Geo_{Fj} are a set of geographical variables such as ruggedness or common sea, λ_t and λ_k are time and designation fixed effects, respectively, and ε_{Fjkt} is the error term.

4.2 Estimation methods

Traditionally, the log-linearized form of the gravity model of trade is estimated using fixed effects ordinary least squares (OLS). This common approach in empirical studies of trade, raises several issues that could lead to biased estimates (Santos Silva and Tenreyro, 2006).
The first one is related to the Jensen's inequality, stating that the expected value of the logarithm of a random variable is different from the logarithm of its expected value ($E(\ln(y)) \neq \ln(E[y])$). This entails an heteroskedasticity problem that biased the estimation of the parameters using the OLS estimator (Santos Silva and Tenreyro, 2006).
The second problem raised by the log-linearization of the model is related to the existence of a selection bias linked to the omission of zero-value observations. This issue is of high importance when working on very disaggregated data, where there is a large number of zero-value observations, as in our study. If zero-value observations are not randomly distributed, dropping these observations from the sample by log-linearizing the equation entails a selection bias (Westerlund and Whilhelmsson, 2011). When working on the more disaggregated data (designation x partner x time), our dataset contains more than 30 % of zero-value observations.

In the empirical literature of trade, several methods have been introduced to deal with both zero-value observations and heteroskedasticity issues such as Tobit models (Eaton and Tamura, 2004), two-step Heckman models (Helpman et al., 2008) or Poisson family estimators (Santos Silva and Tenreyro, 2006; Martinez-Zarzoso, 2013). In this paper, we rely on the Poisson Pseudo Maximum Likelihood (PPML) estimator proposed by Santos Silva and Tenreyro (2006). This method has the advantage to deal with both issues and both outperform OLS and Tobit in the presence of heteroskedasticity. Moreover, relying on an Heckman two-step procedure as in Helpman et al. (2008) is only possible under the assumption that all random components of the model are homoskedastic (Santos Silva and Tenreyro, 2015). Furthermore, the PPML remains consistent in case of over-dispersion in the data (Head and Mayer, 2014)

and in case of a high frequency of zeros (Santos Silva and Tenreyro, 2011).
Alternative Poisson estimators have also been applied in the literature. Martinez-Zarzoso (2013) indicates that the Gamma Pseudo Maximum Likelihood (GPML) estimator displays the lowest bias and lowest standard errors in the case of non-zero value observations and the presence of heteroskedasticity while Negative Binomial Poisson Maximum Likelihood (NBPML) estimator could be not appropriate for application to a continuous dependent variable as the estimates depend strongly on an arbitrary choice of measurement for the dependent variable (Boulhol and Bosquet, 2013), here French export flows of wine. Head and Mayer (2013) assess that if the sample is large enough than PPML and GPML should exhibit similar results.

5. Results

5.1 Standard determinants

Table 1 presents the baseline estimations of the gravity model of trade using the PPML estimator. Columns (1) to (5) present results using aggregated data at the country level, while estimations (6) and (7) display results using data at the regional level and estimations (8) and (9) show results at the designation level. First, we notice remark that coefficient estimations are stable and robust to the disaggregation of the data. Second, as expected, we find that market size, as measured by GDP, significantly increase wine trade while geographical distance significantly impedes French exports of wine. Moreover, remoteness has a positive and significant impact of wine trade flows, confirming results from Baldwin and Harrigan (2011) on the extensive margin of trade. However, in the baseline estimations, per capita GDP seems to have no significant impact of French wine trade. Speaking French is also significant and positive in explaining wine trade flows, while sharing a border does not seem to have a clear impact on trade flows. Results concerning the impact of the real exchange rate are in line with the study of Cardebat and Figuet (2017), and indicate that an appreciation of the French currency decreases trade flows. Finally, local production of wine has a significant negative impact on French wine exports, revealing that French wine directly compete with local wines on the targeted market (a positive sign may have reflected that wine producing countries also aims at consuming different varieties).

If these results are in line with previous studies on wine exports (Dal Bianco et al., 2014; Bouët et al., 2017), they could be misleading if dark trade costs are a major barrier to trade flows and inflate the distance coefficient (Head and Mayer, 2013). To investigate this point, we move to specifications enriched with proxies for biological and cultural preferences.

Table 1: PPML estimation of the gravity model: Baseline results

VARIABLES	(1) Total	(2) Total	(3) Total	(4) Total	(5) Total	(6) Region	(7) Region	(8) Designation	(9) Designation
Lgdpd	0.693***	0.681***	0.658***	0.810***	1.297***	0.649***	1.348***	0.681***	1.339***
	(0.134)	(0.135)	(0.143)	(0.165)	(0.137)	(0.0959)	(0.134)	(0.0377)	(0.0509)
lgdpcapd		0.277	0.250	0.0427	0.0437	0.340	-0.0253	0.277***	-0.109
		(0.228)	(0.231)	(0.153)	(0.125)	(0.254)	(0.271)	(0.0856)	(0.0819)
Lrer			-0.0737	-0.0279	-0.304***		-0.105		-0.183***
			(0.112)	(0.120)	(0.0974)		(0.0854)		(0.0341)
Ldist	-0.584***	-0.535***	-0.483***	-0.781***	-0.390***	-0.457***	-0.332**	-0.535***	-0.325***
	(0.137)	(0.152)	(0.173)	(0.146)	(0.140)	(0.110)	(0.152)	(0.0426)	(0.0598)
contig				-1.057**	0.579		0.545		0.707***
				(0.468)	(0.527)		(0.540)		(0.179)
comlang_off				0.977*	0.551		0.891**		0.520***
				(0.527)	(0.433)		(0.388)		(0.135)
lProd					-0.261***		-0.268***		-0.283***
					(0.0571)		(0.0447)		(0.0185)
ln_REM_head	0.393**	0.386**	0.361**	0.457***	0.120	0.399***	0.172*	0.386***	0.146***
	(0.155)	(0.164)	(0.149)	(0.143)	(0.105)	(0.101)	(0.0890)	(0.0439)	(0.0447)
Constant	3.453	0.579	0.992	1.911	-16.51***	-2.846	-20.26***	-5.839***	-22.37***
	(3.934)	(4.326)	(4.609)	(4.592)	(4.702)	(3.426)	(3.712)	(1.278)	(1.615)
Observations	486	486	485	485	459	3,888	3,672	76,788	71,145
R-squared	0.582	0.579	0.576	0.713	0.861	0.234	0.346	0.472	0.595
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	NO	NO	NO	NO	NO	NO	NO	NO	NO
Designation FE	NO	NO	NO	NO	NO	NO	NO	YES	YES
Region FE	NO	NO	NO	NO	NO	YES	YES	NO	NO

Standard errors in brackets are clustered by country in estimations (1) to (5), by country-region in estimations (6) and (7) and by country-designation in estimations (8) and (9)

*** p<0.01, ** p<0.05, * p<0.1

5.2 Genetics and culture

We rely on a measure of genetic distance, which may capture different aspects. As argued above, genetics may play a role in determining local preferences so that a measure of genetic proximity may reveal how French wine fit the long-lasting structure of wine preference among various wine consumers in the world (see Piratsu et al., 2015). Moreover, genetic distance is a good proxy for differences in tastes due to culture. Genetic distance has been used as a proxy of vertical transmission of cultural traits in many studies (Cavalli-Sforza et al., 1994; Cavalli-Sforza and Feldman, 1981; Stone and Lurquin, 2007: Spolaore and Wacziarg, 2009, 2016). Recently, Spolaore and Wacziarg (2017) have shown that ancestral distance, measured by genetic distance, is highly correlated with cultural distance in the World Values Survey

Both biological and cultural determinants of taste hinge to the notion of dark trade costs, to the extent the preference heterogeneity is an important determinant of trade. To the best of our knowledge, genetic distance has rarely been used in the trade literature. An exception is Guiliano et al. (2014) who show that genetic distance captures geographic factors that are often missing in trade models, because these factors have shaped genetic patterns in the past.[12] While these authors focus on trade overall, we argue that things may be very different for a specific good as wine. For one thing, wine has traditionally been shaped by boat and, for the major consumers in mainland Europe, the generalized development of road infrastructure on this continent has considerably eased the land transportation of wine. Moreover, we focus on a cultural good for which trade laws may differ. It is likely that cultural proximity, reasonably captured by genetic distance, may play a considerable role in exports flows.

Table 2 presents the same estimations as in Table 1, but include a weighted measure of genetic distance taken from Spolaore and Wacziarg (2016) in the gravity model. We find very similar results for traditional gravity variables such as border effect, market size, income effect (i.e. per capita GDP), common language and bilateral exchange rate. Using more disaggregated data, we find that both geographical and genetic distances significantly deter French wine trade. The elasticity associated with genetic distance is even higher than the one estimated for geographical distance. Therefore, ancestral distance, which is historically determined and exhibits strong persistence over time, is a crucial factor affecting wine trade. This result indicates that dark trade costs related to preference heterogeneity represent a crucial factor explaining trade.

However, as shown in Giuliano et al. (2014), the effect of the genetic distance on trade could essentially be linked to other geographical factors such as ruggedness or the existence of a common sea. Note, that contrary to Giuliano et al. (2014), our measure of genetic distance is always significant, even when we control for geographic distance. To test the robustness of our results to the introduction of other geographical factors, we estimate in Table 3, the gravity model of trade controlling for ruggedness, the existence of a common sea and the number of mountains between countries as in Giuliano et al. (2014). Note that we introduce a dummy variable capturing all American destinations (the U.S., Canada, Mexico and Brazil) as we could not measure the number of mountains between France and these countries.

[12] The effect of genetic distance disappears when the authors control for very detailed measures of microgeography, especially in the case of bulky goods for which geographical barriers are more of an impediment to trade.

Table 2: PPML estimation of the gravity model: Genetic distance included

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Total	Total	Total	Total	Total	Region	Region	Designation	Designation
lgdpd	0.883***	0.888***	0.855***	1.132***	1.376***	0.851***	1.399***	0.888***	1.376***
	(0.120)	(0.119)	(0.107)	(0.134)	(0.105)	(0.105)	(0.122)	(0.0361)	(0.0489)
lgdpcapd		0.346*	0.474**	0.264	0.1000	0.420*	0.138	0.346***	0.1000
		(0.194)	(0.206)	(0.199)	(0.140)	(0.251)	(0.209)	(0.0813)	(0.0747)
lrer			-0.283**	-0.188	-0.252**		-0.165		-0.252***
			(0.112)	(0.145)	(0.110)		(0.101)		(0.0518)
Asia	1.361***	1.601***	2.588***	2.865***	2.037***	1.659***	1.956***	1.601***	2.037***
	(0.448)	(0.474)	(0.693)	(0.699)	(0.529)	(0.450)	(0.589)	(0.160)	(0.253)
lgen	-0.543**	-0.542**	-0.535**	-0.762***	-0.527***	-0.515***	-0.546***	-0.542***	-0.527***
	(0.235)	(0.224)	(0.220)	(0.167)	(0.0982)	(0.117)	(0.123)	(0.0543)	(0.0561)
contig				-1.227***	0.0315		-0.0913		0.0315
				(0.301)	(0.305)		(0.486)		(0.152)
comlang_off				1.191***	0.781***		1.123***		0.781***
				(0.326)	(0.258)		(0.332)		(0.116)
lProd					-0.193***		-0.186***		-0.193***
					(0.0388)		(0.0431)		(0.0143)
ldist	-0.370	-0.366	-0.309	-0.546***	-0.289***	-0.326**	-0.275*	-0.366***	-0.289***
	(0.233)	(0.226)	(0.205)	(0.103)	(0.0734)	(0.131)	(0.167)	(0.0572)	(0.0577)
ln_REM_head	0.210*	0.191	0.129	0.184**	0.0236	0.210**	0.0550	0.191***	0.0236
	(0.122)	(0.126)	(0.123)	(0.0876)	(0.0672)	(0.0973)	(0.0727)	(0.0416)	(0.0416)
Constant	-8.039	-11.83**	-12.94**	-17.61***	-24.40***	-15.10***	-28.51***	-18.56***	-30.56***
	(4.989)	(4.935)	(5.299)	(4.821)	(3.936)	(4.018)	(3.985)	(1.504)	(1.832)
Observations	486	486	485	485	459	3,888	3,672	76,788	71,145
R-squared	0.639	0.653	0.698	0.889	0.923	0.266	0.378	0.511	0.636
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	NO	NO	NO	NO	NO	NO	NO	NO	NO
Designation FE	NO	NO	NO	NO	NO	NO	YES	YES	YES
Region FE	NO	NO	NO	NO	NO	YES	YES	NO	NO

Standard errors in brackets are clustered by country in estimations (1) to (5), by country-region in estimations (6) and (7) and by country-designation in estimations (8) and (9).

*** p<0.01, ** p<0.05, * p<0.1

As displayed, in Table 3, we find that the negative effect of genetic distance on French wine exports in robust to the inclusion of geography controls used in the study of Giuliano et al. (2014) and the existence of a common currency. As a consequence, genetic distance is not only associated with geographical factors but also proxies for other hidden trade frictions, i.e. the dark trade costs. This result is line with the study of Spolaore and Wacziarg (2016) who find that the weighted genetic distance measure is significant and negative in explaining per capita income of countries after controlling for distance and geographical factors. In this paper, we argue that genetic distance is linked to difference in tastes and culture. In fact, the hypothesis of localized tastes is linked to history as the difference in genetics between populations. As a consequence, history of tastes are important frictions to wine trade and could explain why the coefficient associated with geographical distance is too high in standard gravity model of trade.

Table 3: PPML estimation of the gravity model: Genetic distance and geography controls

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	1	2	3	4	5	6
lgdpd	1.205***	1.246***	1.083***	1.086***	1.069***	1.187***
	(0.0610)	(0.0610)	(0.0499)	(0.0540)	(0.0569)	(0.0731)
lgdpcapd	0.133**	0.146**	0.283***	0.285***	0.229***	0.124
	(0.0662)	(0.0676)	(0.0726)	(0.0736)	(0.0749)	(0.0839)
lgen1	-0.800***	-0.652***	-0.377***	-0.375***	-0.270***	-0.251***
	(0.0768)	(0.0678)	(0.0661)	(0.0652)	(0.0591)	(0.0583)
comlang_off	1.294***	1.500***	1.295***	1.301***	1.433***	1.325***
	(0.113)	(0.113)	(0.103)	(0.109)	(0.158)	(0.154)
comcur		0.528***	0.283***	0.290***	0.273***	0.200**
		(0.0962)	(0.108)	(0.107)	(0.103)	(0.0950)
contig	-1.306***	-1.672***	-1.157***	-1.162***	-1.081***	-0.630***
	(0.121)	(0.137)	(0.145)	(0.145)	(0.147)	(0.151)
rugged			-0.497***	-0.501***	-0.288***	-0.156
			(0.0645)	(0.0659)	(0.0885)	(0.101)
Commonsea				-0.0232	0.140	0.225
				(0.108)	(0.136)	(0.138)
Mountains					-0.541***	-0.613***
					(0.176)	(0.175)
America					-0.910***	-1.137***
					(0.268)	(0.286)
lProd						-0.0727***
						(0.0189)
ldist1	-0.604***	-0.716***	-0.759***	-0.763***	-0.518***	-0.326***
	(0.0495)	(0.0529)	(0.0461)	(0.0511)	(0.0750)	(0.102)
ln_REM_head	0.208***	0.187***	0.107**	0.108**	0.0846*	0.0528
	(0.0465)	(0.0466)	(0.0461)	(0.0453)	(0.0470)	(0.0490)
Constant	-24.88***	-24.71***	-19.69***	-19.72***	-19.96***	-23.58***
	(2.256)	(2.127)	(1.863)	(1.895)	(1.964)	(2.438)
Observations	76,788	76,788	76,788	76,788	76,788	71,145
R-squared	0.615	0.620	0.629	0.629	0.636	0.647
Year dummies	YES	YES	YES	YES	YES	YES
Country FE	NO	NO	NO	NO	NO	NO
Designation FE	YES	YES	YES	YES	YES	YES

Standard errors in brackets are clustered at the country-designation level.
*** p<0.01, ** p<0.05, * p<0.1

5.3 Luxury wines defy gravity

Next, we aim at investigating if luxury wines defy the standard model of trade, i.e. are less sensitive to geographical distance, as suggested in Mayer and Mayneris (2016). We innovate by extending the question to genetic distance. In Table 4, we first use tercile of unit values of exports as a proxy of wine quality. We interact these three terciles (q1, q2 and q3) with the geographical distance and the genetic distance. We also interact tercile of unit values with the GDP of the destination country to check the robustness of our results.

Table 4: PPML estimation of the gravity model: Tercile of unit values

VARIABLES	(1) geo. Distance	(2) geo. distance	(3) genetic distance	(4) genetic distance
Lgdp*q1		0.919***		0.948***
		(0.0491)		(0.0493)
Lgdp*q2		0.935***		0.920***
		(0.0407)		(0.0389)
Lgdp*q3		0.926***		0.880***
		(0.114)		(0.0963)
lgdpcapd	0.460***	0.460***	0.444***	0.442***
	(0.0755)	(0.0756)	(0.0746)	(0.0740)
lrer	-0.261***	-0.261***	-0.264***	-0.262***
	(0.0522)	(0.0521)	(0.0519)	(0.0515)
Ldist*q1	-0.244***	-0.242***		
	(0.0918)	(0.0927)		
Ldist*q2	-0.195***	-0.198***		
	(0.0545)	(0.0557)		
Ldist*q3	-0.0617	-0.0607		
	(0.124)	(0.137)		
q2	-1.236**	-1.646	-0.272	0.592
	(0.531)	(1.417)	(0.317)	(1.564)
q3	-2.803***	-2.993	0.532	2.558
	(1.069)	(3.030)	(0.467)	(3.144)
Asia	2.443***	2.447***	2.412***	2.398***
	(0.260)	(0.261)	(0.251)	(0.249)
Lgen	-0.537***	-0.537***		
	(0.0581)	(0.0581)		
comlang_off	0.668***	0.667***	0.666***	0.670***
	(0.0949)	(0.0955)	(0.0945)	(0.0945)
ln_REM_head	0.0666*	0.0661*	0.0618	0.0622
	(0.0401)	(0.0401)	(0.0396)	(0.0398)
lgdpd	0.930***		0.928***	
	(0.0350)		(0.0346)	
Lgen*q1			-0.597***	-0.605***
			(0.0675)	(0.0677)
Lgen*q2			-0.501***	-0.498***
			(0.0573)	(0.0576)
Lgen*q3			-0.241**	-0.231**
			(0.0951)	(0.0981)
ldist			-0.213***	-0.211***
			(0.0557)	(0.0566)
Constant	-23.10***	-22.83***	-23.53***	-24.14***
	(1.748)	(1.937)	(1.561)	(1.970)
Observations	52,127	52,127	52,127	52,127
R-squared	0.553	0.553	0.553	0.552
Year dummies	YES	YES	YES	YES
Country FE	NO	NO	NO	NO
Designation FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As suggested in Table 4, it turns out that high-end wine products defy gravity. Indeed, we find that the interaction between the last tercile of unit values, i.e. the most expensive wines, and the geographical distance is not significant in estimations (1) and (2), while other variables displaying the expected signs and significance. This confirms results from Fontagné and Hatte (2013) and Martin and Mayneris (2016) in the case of luxury goods. Note that Bouët et al. (2017) also find lower distance effect on French Cognac exports.

On the contrary, when controlling for geographical distance, our results indicate that all interactions between tercile of unit values and genetic distance are significant and negative (estimations (3) and (4)). This highlights the fact that luxury wines defy freight and transportation costs but still suffer from other dark trade costs such as cultural and taste differences.

To investigate deeper, this important outcome, we also look at famous regions (Bordeaux and Bourgogne) versus the rest of France in Table 5. We find that geographical distance affects less Bourgogne and Bordeaux wines than other ones. Especially, it seems that Red and Rosé Bourgogne wines also defy gravity. However, Bordeaux and Bourgogne are still affected by dark trade costs, as the interaction coefficient between these categories of wines and the genetic distance is still negative and significant.

Table 5: PPML estimation of the gravity model: Categories of wine

VARIABLES	(1) All- geo. distance	(2) All- genetic distance	(3) Red and Rosé- geo.distance	(4) Red and Rosé- genetic distance
Lgdpd	0.939***	0.939***	1.000***	1.000***
	(0.0357)	(0.0357)	(0.0398)	(0.0393)
Lgdpcapd	0.416***	0.417***	0.313***	0.313***
	(0.0751)	(0.0736)	(0.0720)	(0.0698)
Ldist*bordeaux	-0.164**		-0.138*	
	(0.0731)		(0.0828)	
Ldist*bourogne	-0.148*		0.0283	
	(0.0827)		(0.108)	
Ldist*otherwine	-0.292***		-0.236***	
	(0.0653)		(0.0808)	
Lrer	-0.281***	-0.282***	-0.262***	-0.263***
	(0.0545)	(0.0543)	(0.0550)	(0.0541)
comlang_off	0.551***	0.553***	0.698***	0.700***
	(0.0999)	(0.0998)	(0.120)	(0.120)
Asia	2.677***	2.664***	3.092***	3.075***
	(0.275)	(0.273)	(0.316)	(0.308)
Lgen	-0.593***		-0.716***	
	(0.0630)		(0.0850)	
ln_REM_head	0.122***	0.122***	0.114**	0.114**
	(0.0381)	(0.0380)	(0.0522)	(0.0522)
Lgen*bordeaux		-0.466***		-0.606***
		(0.0746)		(0.0883)
Lgen*bourgogne		-0.484***		-0.538***
		(0.0715)		(0.103)
Lgen*otherwine		-0.629***		-0.759***
		(0.0654)		(0.0865)
Ldist		-0.261***		-0.204***
		(0.0600)		(0.0737)
Constant	-22.26***	-22.71***	-25.01***	-25.50***
	(1.625)	(1.621)	(2.062)	(2.025)
Observations	76,630	76,630	38,800	38,800
R-squared	0.534	0.534	0.569	0.572
Year dummies	YES	YES	YES	YES
Country FE	NO	NO	NO	NO
Designation FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

These results are confirmed in Table 6 on top Bordeaux and Bourgogne wines, i.e. the most expensive ones, where we find that these expensive wines as long as Champagne are less sensitive to geographical distance than other ones, while they are still affected by genetic distance.

Table 6: PPML estimation of the gravity model: Top wines

VARIABLES	(1) geo. distance	(2) geo. distance	(3) genetic distance	(4) genetic distance
Lgdpd	0.939***	0.938***	0.939***	0.937***
	(0.0358)	(0.0357)	(0.0357)	(0.0357)
Lgdpcapd	0.418***	0.418***	0.419***	0.419***
	(0.0766)	(0.0763)	(0.0766)	(0.0769)
Ldist*Bordtop	-0.0486**	-0.0474		
	(0.0217)	(0.122)		
Ldist*Bourtop	0.00172	0.0888		
	(0.0228)	(0.0951)		
Ldist*champ		-0.270*		
		(0.164)		
Ldist*otherwine3		-0.265***		
		(0.0588)		
Asia	2.676***	2.667***	2.670***	2.660***
	(0.276)	(0.276)	(0.275)	(0.273)
lgen	-0.591***	-0.589***	-0.591***	
	(0.0631)	(0.0630)	(0.0630)	
Lrer	-0.281***	-0.281***	-0.282***	-0.281***
	(0.0548)	(0.0549)	(0.0548)	(0.0544)
comlang_off	0.552***	0.549***	0.549***	0.549***
	(0.0990)	(0.0989)	(0.0990)	(0.0986)
ln_REM_head	0.122***	0.120***	0.121***	0.119***
	(0.0381)	(0.0381)	(0.0381)	(0.0381)
Bordtop		-2.214**		
		(0.941)		
Bourtop		-2.996***		
		(0.635)		
champ		-0.0439		
		(1.041)		
ldist1	-0.260***		-0.261***	-0.259***
	(0.0604)		(0.0603)	(0.0603)
Lgen*Bordtop			0.139***	-0.452***
			(0.0277)	(0.0705)
Lgen*Bourtop			0.0724***	-0.518***
			(0.0206)	(0.0654)
Lgen*champ				-0.559***
				(0.0647)
Lgen*otherwine				-0.591***
				(0.0630)
Constant	-22.49***	-22.43***	-22.48***	-22.47***
	(1.626)	(1.624)	(1.623)	(1.623)
Observations	76,630	76,630	76,630	76,630
R-squared	0.530	0.530	0.530	0.528
Year dummies	YES	YES	YES	YES
Country FE	NO	NO	NO	NO
Designation FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Finally, in Tables 6 and 7, we investigate results within Bordeaux and Bourgogne regions of exports. We find that Medoc, Saint Emilion, Pessac Leognan and Doux wines are not sensitive to geographical distance, but they are highly sensitive to genetic distance. These very famous wines depend, therefore, essentially on income, market size and dark trade costs. Our results concerning Bourgogne are quite different because we find that Bourgogne top wines seem to defy both gravity and genetics.

Table 6: PPML estimation of the gravity model: Within Bordeaux

VARIABLES	(1) geo. distance	(2) geo. distance	(3) genetic distance	(4) genetic distance
lgdpd	0.960***	0.960***	0.960***	0.960***
	(0.0701)	(0.0703)	(0.0700)	(0.0703)
lgdpcapd	0.223***	0.223***	0.222**	0.222**
	(0.0861)	(0.0863)	(0.0866)	(0.0868)
Ldist*Medoc		-0.207		
		(0.155)		
Ldist*Emil		-0.205		
		(0.188)		
Ldist*Doux		-0.206		
		(0.156)		
Ldist*Pessac		-0.177		
		(0.137)		
Ldist*otherBx		-0.325***		
		(0.0806)		
Asia	3.117***	3.116***	3.110***	3.108***
	(0.441)	(0.441)	(0.441)	(0.442)
Lgen	-0.581***	-0.580***		
	(0.105)	(0.106)		
comlang_off	0.992***	0.994***	0.992***	0.993***
	(0.168)	(0.168)	(0.168)	(0.168)
Lrer	-0.202***	-0.202***	-0.203***	-0.202***
	(0.0741)	(0.0742)	(0.0744)	(0.0745)
ln_REM_head	0.205***	0.206***	0.204***	0.205***
	(0.0638)	(0.0639)	(0.0639)	(0.0640)
Ldist*Bordtop	-0.203			
	(0.125)			
Ldist*Bordnotop	-0.325***			
	(0.0805)			
Bordtop	-1.399		0.319	
	(0.884)		(0.504)	
Lgen*Bordtop			-0.446***	
			(0.133)	
Lgen*Bordnotop			-0.591***	
			(0.105)	
Ldist			-0.315***	-0.315***
			(0.0789)	(0.0790)
Lgen*Medoc				-0.447***
				(0.147)
Lgen*Emil				-0.454**
				(0.188)
Lgen*Doux				-0.447***
				(0.147)

Lgen*Pessac				-0.430***
				(0.145)
Lgen*otherBx				-0.591***
				(0.105)
Constant	-21.60***	-20.81***	-21.72***	-20.95***
	(2.731)	(2.730)	(2.688)	(2.689)
Observations	8,245	8,245	8,245	8,245
R-squared	0.643	0.643	0.642	0.642
Year dummies	YES	YES	YES	YES
Country FE	NO	NO	NO	NO
Designation FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: PPML estimation of the gravity model: Within Bourgogne

	(1)	(2)
VARIABLES	geo. distance	genetic distance
lgdpd	0.947***	0.947***
	(0.0555)	(0.0554)
lgdpcapd	0.939***	0.940***
	(0.113)	(0.113)
Ldist*Bourtop	-0.0394	
	(0.105)	
Ldist*Bournotop	-0.314***	
	(0.117)	
Bourtop	-2.527***	1.097***
	(0.713)	(0.406)
Asia	1.554***	1.529***
	(0.305)	(0.304)
Lgen	-0.356***	
	(0.0888)	
Lrer	-0.112*	-0.113*
	(0.0643)	(0.0643)
comlang_off	0.374*	0.378*
	(0.226)	(0.224)
ln_REM_head	0.0989	0.0998
	(0.0630)	(0.0627)
Lgen*Bourtop		-0.0921
		(0.107)
Lgen*Bournotop		-0.368***
		(0.0886)
Ldist		-0.297***
		(0.115)
Constant	-26.60***	-26.78***
	(2.522)	(2.495)
Observations	8,730	8,730
R-squared	0.368	0.367
Year dummies	YES	YES
Country FE	NO	NO
Designation FE	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusion

This paper exploits a novel dataset on the export of French wine in the world over 1988-2015, with very detailed information on export flows in volume and value terms across 400 different types of French wines. The estimation of a gravity model allows disentangling the main determinants of French wine exports over the period. We first find that wine exports respond to standard trade frictions and trade determinants including GDP, GDP per capita, exchange rate and the existence of a common language. Yet, luxury wines (last tercile of unit values or top regions) tend to defy gravity since distance plays less of a role and has even no effect for top wines like Grands Crus from Bordeaux and Bourgogne. Moreover, original factors emerge from our estimation: cultural differences (tastes), as proxied by genetics, are important factor driving wine trade flows. Further work show focus on the heterogeneity in tastes across countries and regions, and color and regions. It will also investigate the determinants at the extensive margin of trade (Santos Silva et al., 2014).

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