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The Impact of Exchange Rates on French Wine Exports

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Abstract

In this article, we analyze the impact of varying exchange rates on French wine exports using a dynamic Armington panel model for the time period from 2000 to 2011. Our results suggest that French wines have become less competitive during the 2000s. This is due to two factors: rising domestic wine prices relative to foreign competitors and the appreciation of the euro against the USD and the GBP. Chinese demand appears to be a key driver of French wine exports. In addition, we find some compositional effects in Bordeaux wine exports. In response to the appreciation of the euro, the share of high-priced wines has increased, suggesting some degree of quality sorting in response to exchange-rate changes. (JEL Classification: F14, F31, Q17)

Keywords: exchange rates, French wine exports, wine quality.

I. Introduction

This article is set out to analyze the exchange-rate dependency of French wine exports. The international trade literature usually refers to three determinants. The first two are foreign demand (determined by country income and tastes) and price competitiveness (determined by relative prices and nominal exchange rates (NER)) (see, e.g., Warner and Kreinin, 1983). The third, which has appeared more recently in the empirical literature (Hallak, 2006), is non-price competitiveness (particularly the quality of goods). In this literature, the impact of the exchange rate has been stressed several times (see, e.g., Junz and Rhomberg, 1973; Goldstein and Khan, 1985; Chowdhury, 1993; Bahmani-Oskooee and Ardalani, 2006; Eichengreen

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and Gupta, 2013). The message of these articles is that exchange-rate variations can have a substantial impact on exports volume.

Nevertheless, only a few economics articles[1] focus on the wine sector. Anderson and Wittwer (2001, 2013) use a computable general equilibrium model (CGEM) to assess the impact of changes in world demand and real exchange rate (RER) on wine exports volume (and also on production and consumption). In their latest article, they show that the RER changes operated in favor of the United States and the European Union against New World wine-exporting countries (especially Australia) between 2007 and 2011. Crozet, Head, and Mayer (2012) employ a quality interpretation of the Melitz (2003) model of firm heterogeneity and trade to analyze Champagne wine exports volume at firm level. They stress the crucial role of quality in explaining the export performance. Nevertheless, they do not explicitly introduce the exchange rate in their analysis. Robinson (2009) analyzes exchange rate pass-throughs of imported wines in the U.S. market. Drawing on a static panel model she finds a pass-through value of about 62% for French wines imported into the United States; the dynamic panel model yields pass-through values of 48% in the short run and 73% in the long run.

The purpose of this article is to analyze the impact of exchange rates on French wine exports. We collected data on 265 types of wines over the 2000 to 2011 period from FEVS,[2] and conducted a dynamic panel data analysis based on the Armington model,[3] augmented by a quality variable.

We find that exchange-rate variations exert a significant impact on wine exports. We also find positive and significant income elasticities and negative relative price elasticities. However, these results vary among specific *appellations* and quality levels. In particular, wines from the Bordeaux *appellation* have seen growing exports in spite of rising exchange rates. This paradox may be explained by quality sorting in export/import flows in line with the recent international trade literature.

The remainder of this article is organized as follows. Section II describes the data, Section III presents the methodology, Section IV reports and interprets the results, and Section V concludes.

II. Data

We collected export information on 265 types of French wine covering the time from 2000 to 2011 and the top seven countries (Belgium, Germany, China and Hong Kong, Japan, the United States, and the United Kingdom) to which they were

[1] The business and management literature on export performance (see, e.g., Maurel, 2009; Silverman, Sengupta, and Castaldi, 2004; Karelakis, Mattas, and Chryssochoidis, 2008) focuses on firm determinants rather than economic determinants such as exchange rates or foreign incomes.
[2] Fédération des Exportateurs de Vins et Spiritueux *(Wine and Spirits Exporter Federation)*.
[3] See Armington (1969).

exported. A type of wine depends on how the wine is packaged (in bottle or in bulk), its color, and its *appellation*. Table 1 gives the key features of the French wine sector.

We organize our dataset as a panel with the three dimensions time (12 years), destination (7 countries), and type of wine (265 different types according to packaging, color, and *appellation* of origin). Our dependent variables are value, volume, and price of exports for each type of wine. A unit is a case of 12 bottles of wine. Table 2 provides the descriptive statistics for all variables.

These data represent the finest level of disaggregation available in French trade statistics. Due to the French market organization, direct trade flows from producers to foreign markets are unavailable. Data from the French national statistical agency (INSEE, 2014)[4] indicate that 110,000 grape growers or winemakers mainly sell their products to *négociants. Négociants* are middlemen between producers and retailers. The 300 *négociants* in Bordeaux account for nearly 90% of all Bordeaux wine exports by volume.

In France, there is no tradition of long-term contracts between the producers and *négociants,* that is, business relationships are based on trust. Also there are not long-term contracts between *négociants* and wine importers. Volumes and prices (in €, except in Canada in our dataset) are, therefore, fixed yearly. Foreign income level, quality (vintage effect for fine wine), competition, and price are, therefore, the main determinants of wine exports volume. The level of aggregation raises concerns about the methodology to be used and the interpretation of the results (see the next two sections).

According to FEVS (2014) statistics, more than 80% of all French still wines are exported to the seven countries previously mentioned. In France, a wine qualifies for *Appellation d'Origine Protégée* (PDO) if its principal stages of production are carried out according to certain rules within the same geographical area, which defines the product and its characteristics. The *Appellation d'Origine Contrôlée* (AOC) status is awarded to wines that meet the criteria of the PDO and protect the denomination on the French territory (INAO, 2015).[5] Bordeaux is the leading *appellation* region in volume and value, followed by Burgundy and Beaujolais. Exports from these *appellations* make up more than 50% of the total export value over the period.

III. Methodology

The Armington model assumes that products are different based on their geographical origin, and that consumer preferences for a product are unaffected (or only slightly affected) by their purchases of other products. Using these assumptions

[4] See http://www.insee.fr/fr/bases-de-donnees/default.asp?page=presentation-stat-annuelle-entreprise.htm.
[5] In annex 1, a map gives the details of the French wine *appellations.*

Table 1
The French Wine Sector

	2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2000–2011*	*2000–2005*	*2006–2011*
French area (1000 ha)	907.0	900.0	898.1	888.4	889.0	894.9	887.5	867.4	856.8	836.1	818.0	806.0	−101.0	−12.1	−81.5
Year on year change (%)		−0.8	−0.2	−1.1	0.1	0.7	−0.8	−2.3	−1.2	−2.4	−2.2	−1.5	−11.1	−1.4	−9.2
Bordeaux area (1000 ha)	118.5	120.2	121.6	123.9	124.6	124.7	124	122.2	120.8	119.5	117.2	117	−1.5	6.2	−7
Year on year change (%)		1.4	1.16	1.9	0.6	0.1	−0.6	−1.5	−1.2	−1.1	−1.9	−0.2	−1.3	5.1	−5.7
French production (1000 hl)	57.54	53.39	50.35	46.36	57.39	52.11	52.13	45.67	42.65	46.27	44.38	50.76	−6.78	−5.43	−1.37
Year on year change (%)		−7.2	−5.7	−7.9	23.8	−9.2	0.04	−12.4	−6.6	8.5	−4.1	14.4	−11.8	−10.8	−3.0
Bordeaux production (1000 hl)	6.10	5.93	5.00	5.12	6.66	6.00	5.90	5.69	4.80	5.75	5.71	5.46	−0.64	−0.10	−0.44
Year on year change (%)		−2.8	−15.7	2.4	30.1	−9.9	−1.7	−3.6	−15.6	19.8	−0.7	−4.4	−10.5	−2.0	−8.6
French exports (1000 hl)	15.04	15.13	15.54	15.15	14.21	13.83	14.86	14.51	12.8	12.97	13.89	14.72	−0.32	−1.21	−0.14
Year on year change (%)		0.6	2.7	−2.5	−6.2	−2.7	7.5	−2.4	−11.8	1.3	7.1	6.0	−2.1	−7.8	−0.9
Bordeaux exports (1000 hl)	1.70	1.82	1.91	2.02	1.68	1.74	1.81	1.98	1.88	1.62	1.85	2.25	0.55	0.04	0.44
Year on year change (%)		7.1	5.0	5.7	−16.8	3.6	4.0	9.4	−5.1	−13.8	14.2	21.6	32.4	2.1	21.8
French exports/French production (%)	26.1	28.3	30.9	32.7	24.8	26.5	28.5	31.8	30.0	28.03	31.3	29.00	2.86	0.40	0.49
Year on year change (%)		8.4	8.9	5.9	−24.2	7.2	7.4	11.5	−5.5	−6.6	11.7	−7.3	11.0	1.3	1.5
Bordeaux exports/Bordeaux production (%)	27.9	30.7	38.2	39.5	25.2	29.0	30.7	34.8	39.2	28.2	32.4	41.2	13.3	11.3	10.5
Year on year change (%)		10.1	24.5	3.3	−36.1	15.0	5.8	13.4	12.6	−28.1	15.0	27.2	47.9	3.0	26.7

Sources: OIV Statistics (2014) and Agreste (2014).

Table 2
Descriptive Statistics

2000–2011, Yearly Data	*Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
Value (thousand euros)					
Germany	3,180	456,234	42,765	407,961	518,226
Belgium	3,180	430,753	25,334	375,529	469,854
United States	3,180	530,127	71,652	421,344	631,421
China	3,180	91,725	142,602	4,210	471,494
Hong Kong	3,180	98,130	122,197	23,002	401,289
Japan	3,180	290,189	18,893	250,761	314,039
United Kingdom	3,180	753,969	75,023	660,794	883,735
Volume (case of 12 bottles)					
Germany	3,180	2,645,637	2,707,583	2,330,780	3,096,044
Belgium	3,180	1,764,593	1,388,939	1,516,125	1,918,736
United States	3,180	9,123,560	931,238	7,972,669	10,417,769
China	3,180	2,706,954	364,581	261,653	11,462,610
Hong Kong	3,180	798,725	526,471	442,794	2,067,297
Japan	3,180	5,893,349	42,9374	514,181	6,485,996
Exchange rate					
€/USD	12	1.22	0.19	0.89	1.47
€/JPY	12	128.83	18.71	99.53	161.24
€/GBP	12	0.72	0.10	0.61	0.89
€/HKD	12	9.43	1.60	6.78	11.45
€/CNY	12	9.25	1.09	7.41	10.44

Source: FEVS (2014).

and some simplifications, the demand functions resulting from the maximization of CES utility functions take the multiplicative form (Goldstein and Kahn, 1985):

$$X = a \cdot D^{\alpha} \cdot PC^{\beta} \tag{1}$$

where X is the export volume of a considered good, a is a constant, D is the world demand for the considered good, and PC is a price-competitiveness index that depends on the price of the good in the exporting country and the importing country. Expressed in logarithms, we obtain

$$\log(X) = c + \alpha \log(D) + \beta \log(PC), \tag{2}$$

where c is the logarithm of a. α represents the demand elasticity for the exported good and β represents the price elasticity of the export volumes. Equation (2) is traditionally considered as the long-term export equation for a specified country (Chiappini, 2011). This model was developed using the imperfect substitute model for multi-sectors, but here we apply it to a single sector.

Empirical trade literature, however, stresses that this model only considers price competitiveness and ignores other dimensions of competitiveness that may be export relevant (Fagerberg, 1988; Junz and Rhomberg, 1973). A fair amount of

research, therefore, has focused on how to augment the *Armingtonian* approach. Empirical studies have shown that a high level of innovation or a high level of quality can explain the export performance of a product from a specific country. Examples of these works include Amable and Verspagen (1995), who studied the role of innovation and technology in trade performance, and Crozet and Erkel-Rousse (2004), who created a quality indicator based on perceived quality of goods. Hallak (2006) and Hallak and Schott (2011) linked the perceived quality with the prices of exported goods. "Quality differences are presumably one of the main sources of cross-country variation in export prices," but Hallak (2006, p. 255) added that "However, this variation might also reflect differences in prices for goods of the same quality, which might stem, for example, from differences in production costs." We, therefore, conclude that there is no perfect quality indicator for specific goods in international trade.

Quality is a major factor in sales and trade performance in the wine sector. Wine is not only a highly-differentiated good, it is an experienced good, and consumers will only know its quality after consumption. This makes quality assessments particularly difficult. Nevertheless, the denomination by origin (DO, in French: AOC) provides objective information on how a wine is produced. Each AOC uses very specific reference terms (*cahier des charges*), which indicate the quality and specificity of a given *terroir* (soil, varietal specificities, wine type, etc.). In this article, we will consider DO as the best proxy for wine quality that can be found.[6] Information about a wine's DO is publicly available and easy to understand.

Augmenting Equation (2) with a quality variable, we derive the following general regression model as

$$logX_{kit} = \alpha_i + \beta \cdot logRER_{kit} + \gamma \cdot logGDPh_{kit} + \sum_j (\delta_j \cdot DO_j) + \varepsilon_{kit}, \qquad (3)$$

All continuous variables are expressed as logarithms. The index $k = 1, \ldots, 265$ denotes the wine type (*appellation*, color, and packaging); $i = 1, \ldots, 7$ represents the number of destination countries, and $t = 2000, \ldots, 2011$ refers to the years. X represents the export volume of wine k to country i in year t. RER is the real exchange rate of the euro against country i's currency. *GDP* per capita (*GDPh*), obtained from the World Bank, reflects the foreign demand directed to the home country in case of vertically-differentiated trade (Durkin and Krygier, 2000; Deardorff, 1984). Because we added a quality variable, we have to account for the possibility of non-homothetic demand for quality, which we achieve by using gross domestic product (GDP) per capita rather than traditional GDP (Hummels and Skiba, 2004). We model

[6] Another way to measure wine quality used in wine economics are expert ratings. These ratings, however, only refer to individual wines, not an aggregated DO or all French wines as a whole. In addition, only high-quality wines are rated by experts. Critical wine scores, therefore, may serve as useful quality variables for analyzing the exports of single wines, but cannot be employed for data at a higher aggregation level.

importer-specific characteristics by including time-invariant country-fixed effects (α_i). DO_j is a dummy variable that equals 1 for wine type k of the j^{th} denomination of origin j, and 0 otherwise. DO_j represents the perceived quality of an exported wine and ε_{kit} is the error term.

As mentioned in the Introduction, the RER represents a traditional price-competitiveness variable and has two components (Dornbusch, 1987): the NER and a relative price index, such that

$$RER = NER \cdot \frac{P}{P^*}.$$

In the general formulation of the RER, P (P^*) is the national (foreign) price index. A decrease in competitiveness for a given country can result from an appreciation of the domestic exchange rate, from a relative increase in domestic prices (compared to foreign prices), or both. In this specific partial equilibrium case of French wine exports, P is the average wine price for each of the 265 types of French wines, and is calculated by dividing the value of the exported wine by the respective volume. P^* is the average price of foreign wines from major competitors (Italy, Spain, Argentina, Australia, Chile, Germany, Portugal, South Africa, and the United States) that are considered substitutes for French wines in the main importing countries. Data are extracted from OIV (2014) statistics. Thus, we define P_{kit} as the relative price in year t of French wine k exported to country i (i.e., the unit value of the wine k divided by the average wine price in the main wine-producing countries, exported to country i in year t). Therefore,

$$logRER_{kit} = logNER_{kit} + logP_{kit}. \tag{4}$$

Combining Equations (3) and (4) creates the following:

$$\begin{aligned} logX_{kit} = \alpha_i + \rho \cdot logNER_{kit} + \ \theta \cdot logP_{kit} \\ + \gamma \cdot logGDPh_{kit} + \sum_j (\delta_j \cdot DO_j) + \varepsilon_{kit}. \end{aligned} \tag{5}$$

In Equation (5), we split the coefficient beta (see Equation (3)) into two different coefficients (rho and theta) because Equation (4) is written in the general case (where P and P^* are both general consumer-price indexes), but cannot be considered as a strict identity when one is dealing with a partial equilibrium (i.e., a single market like the wine market). Hence, preserving the same coefficient for NER and P in Equation (5) would be too strong a constraint and does not reflect the reality in a partial equilibrium. P and P^* are industry-level prices. They are not the only forces on the NER to move RER to 1 in accordance with PPP. The NER will adjust to prices across all industries. In Equation (5), rho and theta measure price competitiveness. But identification of theta comes

from industry-level variation in relative wine prices, and this is not perfectly correlated with NER, which responds to country-level price competitiveness.

Equation (5) decomposes the price-competitiveness effect stemming from nominal exchange-rate variations and from relative price variations of French wines. However, when we use Equation (5), we must accept the implicit assumption of an instantaneous (within a year) link between exchange-rate variations and volume of exports. Nonetheless, we learned from the well-known J-curve phenomenon (e.g., Junz and Rhomberg, 1973) that export volumes may need more than one year to adjust after exchange-rate changes. Long-term contracts, strong habits, and partnerships between importers and exporters are some common explanations for this lag. We could capture these lags in the export-volume adjustments by introducing a lagged dependent variable on the right side of Equation (5). This solution would not only have the advantage of taking into consideration the hysteresis effect of trade volume, but also modeling the long-term effect of the exchange rate on trade volume (because X_{kit-1} contains NER_{kit-1}). The dynamic model obtained from Equation (5) is given by

$$\begin{aligned} logX_{kit} = \alpha_i + \sigma \cdot \log(X_{kit-1}) + \rho \cdot logNER_{kit} + \ \theta \cdot logP_{kit} \\ + \gamma \cdot logGDPh_{kit} + \ \sum_j (\delta_j \cdot DO_j) + \varepsilon_{kit}. \end{aligned} \tag{6}$$

This dynamic panel model specification is known as the Koyck lag model. The short-run (same-period) effect of a 1% change in the exchange rate is given directly by ρ while the long-run (cumulative) effect of a sustained 1% change in the exchange rate is $\left(\frac{\rho}{1-\sigma}\right)$.

This specification, however, creates a correlation problem between X_{kit-1}, the fixed effects α_i and the error term ε_{kit}. To avoid this problem, we use a generalized method of moments (GMM) procedure that consists of a first difference transformation of Model (6) and then uses higher-order lags as instruments for the lagged dependent variable (X_{kit-1}), as suggested by Arellano and Bond (1991). The application of this GMM-DIFF estimator allows for a consistent estimate of the short- and long-term effects of the exchange rate on export volumes.

The estimation in first difference, however, implies the disappearance of the fixed quality of any given type of wine (DO). Equation (5) can then be useful to create a short-term estimate of the quality coefficients in order to complete the long-term analysis (Equation (6)). Nevertheless, quality variables are used in the long-term estimate to distinguish the effect of the exchange rate depending on the quality of the wine. Following the J-curve theory, our hypothesis is that the long-term export-volume reaction to exchange-rate variations might be different depending on the quality of the wine under consideration. This is due to strategic adaptations by the importers and/or exporters that only apply in the long term. In other words, prestigious and basic wines might differ in their response when faced with the same

exchange-rate variations (and income and relative price variations). Thus, Equation (6) becomes

$$logX_{kit} = \alpha_i + \sigma \cdot \log(X_{kit-1}) + \rho \cdot \sum_j DO_j \cdot logNER_{kit} + \theta \cdot \sum_j DO_j \cdot logP_{kit} + \gamma \cdot \sum_j DO_j \cdot logGDPh_{kit} + \varepsilon_{kit}. \quad (7)$$

Equation (7) allows for differentiated effects of the exogenous variables depending on the quality range of the types of wine (different AOCs, but also, different colors and packaging). In particular, we are interested in examining whether exchange-rate variations affect the exports of wines from different AOCs in the same way. Chiappini (2012) uses a similar equation to explain exports in the European automotive industry. He concludes that organization of production is an explanatory variable, but cost competitiveness and quality are also significant variables. In addition, we also run some robustness checks to test whether the effect of the exchange rate is similar for each country.

IV. Results and Interpretation

The results section is organized as follows. First, we report the results of the static model (Table 3). In order to test for robustness, we then compare the basic Armingtonian model (Model 1) to the estimate augmented by quality variables issued from Equation (5). This first analysis is completed by a dynamic estimate that does not capture the effect of quality variables, but takes into account the differentiated effect of the exogenous variables on the volume exported, based on the quality of the wine (as determined by the DO). The results of the dynamic estimates are displayed in Table 4. Tables 5 and 6 offer some additional robustness.

A. Static Model

In this section we present the outcomes of the static model (Table 3). The main results suggest the following.

- The exchange rate exerts a statistically-significant negative impact on French wine exports volume. An appreciation of the euro by 10% causes a decrease in exports of about 2% by volume. This result seems robust insofar as all models report similar coefficients.
- Income elasticities and relative price elasticities are high, statistically significant, and show the expected signs.
- The quality variables (i.e., DO) are significant with the expected signs. The higher the quality associated with the wine, the higher the volume exported. Models 1' and 1'' suggest that Bordeaux and Burgundy are strongly associated

Table 3
Exchange-Rate Effects on Export Volumes Static Model 2000–2011

	Model 1	*Model 1'*	*Model 1"*
Constant	−0.439 (0.652)	−0.527 (0.638)	−0.592 (0.639)
GDP per capita (GDP)	1.237*** (0.141)	1.320*** (0.133)	1.345*** (0.138)
Exchange rate (ER)	−0.225*** (0.043)	−0.184*** (0.041)	−0.191*** (0.040)
Relative price (RP)	−0.855*** (0.063)	−1.219*** (0.059)	−1.192*** (0.056)
Bordeaux	—	0.527*** (0.085)	—
Communales du Médoc[a]	—	—	2.310*** (0.138)
Médoc	—	—	1.631*** (0.075)
Saint-Emilion	—	—	1.653*** (0.081)
Bourgogne	—	0.874*** (0.075)	0.785*** (0.071)
Loire	—	−0.280*** (0.071)	−0.358*** (0.069)
Languedoc	—	−0.220*** (0.075)	−0.292*** (0.073)
Observations	13,220	13,220	13,220
Adj. R^2	0.25	0.32	0.34

Fixed-Effect Panel, Ordinary Least Squares; *** Significance at 1%, ** at 5%, * at 10%. Standard errors are in parentheses.

[a]The most prestigious *appellations* of the Bordeaux Médoc region, that is, AOC Margaux, AOC Pauillac, AOC Saint-Juluen, AOC Saint-Estéphe, AOC Moulis, and AOC Listrac.

with higher exports volume, especially for the most prestigious sub-appellations of Bordeaux. On the other hand, less prestigious *appellations* such as Languedoc and Loire, are significantly associated with lower exports volume. The addition of quality variables augments the explanatory power of the basic model and improves the Armington approach. The coefficients of the three main exogenous variables, however, remain relatively stable among all models.

Thus, the Armington model seems to be a robust approach for assessing the impact of the exchange rate on the export of French wines by volume.

B. Dynamic Model

This section displays the results of the dynamic model, which allows for distinguishing for short- and long-term effect of the exchange on exports volume. Furthermore, we also differentiate the exchange-rate impact on exports volume for the DOs of Bordeaux and Burgundy. Regarding the high-end nature of these wines, we assume that the impact of a variation in the exchange rate could differ from the impact on lower-range wines.

In Table 4, Model 2, the coefficients of lagged volume, GDP per capita, relative price, and exchange rate are statistically significant with the expected signs: the income elasticity is positive, while the price elasticity and the exchange-rate elasticity are negative. Concerning the impact of exchange rates on French wine exports volume, the dynamic model suggests that, in the short run, exchange-rate variations

Table 4

Exchange-Rate Effects on Export Volumes Dynamic Panel Model 2000–2011

	Model 2	*Model 2′ T 2000–11*	*Model 2′ T 2000–05*	*Model 2′ T 2006–11*
Volume ($t-1$)	0.200*** (0.039)	0.206*** (0.039)	0.058 (0.092)	0.273*** (0.042)
GDP per capita	0.260*** (0.062)	0.214** (0.086)	−0.207 (0.153)	0.354*** (0.118)
Exchange rate (ER)	−0.457*** (0.122)	−0.788*** (0.153)	−0.690*** (0.248)	−0.676*** (0.218)
Relative price (RP)	−1.024*** (0.040)	−0.974*** (0.059)	−0.995*** (0.116)	−1.073*** (0.066)
Bordeaux*GDP	—	0.111 (0.260)	0.380 (0.279)	0.886*** (0.286)
Burgundy*GDP	—	0.110 (0.276)	0.322 (0.334)	0.896*** (0.308)
Bordeaux*ER	—	1.771*** (0.360)	1.600*** (0.472)	1.868** (0.539)
Burgundy*ER	—	−0.294 (0.105)	0.361 (0.784)	0.869 (0.535)
Bordeaux*RP	—	−1.186*** (0.086)	−0.126 (0.154)	−0.215** (0.095)
Burgundy*RP	—	0.067*** (0.105)	0.126 (0.148)	0.115 (0.138)
Long-term effect of a 1% appreciation in ER				
All wines	−0.571***	−0.992***	−0.732***	−0.930***
Bordeaux		2.230***	1.699***	2.569***
Burgundy		−0.370	0.383	1.195
Observations	9,936	9,936	3694	6148
J-statistic	178.92	182.55	32.33	152.31
Prob (J-statistic)	0.000	0.000	0.000	0.000
Instrument rank	58	64	19	54

All regressions are run GMM. *** Significance at 1%, ** at 5%, * at 10%. The standard errors are in parentheses. GDP is GDP per capita; ER is exchange rate; RP is relative price.

[a] Long-term effect of a 1% variation in ER.

Table 5

Exchange-Rate Effects on Export Volumes, Values, and Prices Dynamic Panel Model 2000–2011

	Volume			*Value*			*Price*		
	All	*Bottled*	*Bulk*	*All*	*Bottled*	*Bulk*	*All*	*Bottled*	*Bulk*
dep. lag(–1)	0.200***	0.305***	0.107**(0.043)	0.234***	0.290***	−0.016	0.186***	0.174***	0.210***
	(0.039)	(0.043)		(0.041)	(0.039)	(0.046)	(0.039)	(0.041)	(0.041)
GDP	0.260***	0.446***	−0.000(0.363)	0.238***	0.421***	0.002	0.229***	0.214***	0.511***
	(0.062)	(0.077)		(0.059)	(0.067)	(0.175)	(0.031)	(0.028)	(0.097)
ER	−0.457***	−0.559***	−3.930**	−0.738***	−0.739***	−0.443	0.029(0.066)	0.127**	0.328(0.226)
	(0.122)	(0.113)	(1.561)	(0.116)	(0.099)	(0.383)		(0.054)	
RP	−1.024***	−0.941***	−1.486***	−0.027(0.038)	0.138**(0.065)	−0.053	—	—	—
	(0.039)	(0.073)	(0.185)			(0.045)			
Long-term effect of a 1% appreciation in ER									
	−0.571***	−0.804***	−4.401**	−0.963***	−1.041***	−0.436	0.036	0.154**	0.415
Observations	9,936	9,936	9,936	9,936	9,936	9,936	9,936	9,936	9,936
J-statistic	178.92	197.06	227.30	208.65	231.80	178.78	112.93	118.87	141.94
Prob (J-statistic)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Instrument rank	58	58	58	58	58	58	57	57	57

All regressions are run GMM. *** Significance at 1%, ** at 5%, * at 10%. The standard errors are in parentheses. GDP is GDP per capita; ER is exchange rate; RP is relative price.

Table 6

Exchange-Rate Effects on Export Volumes by Destination Country Dynamic Panel Model 2000–2011

Variables	*Model 3*		*Model 3'*	
	Coefficient	*Standard Error*	*Coefficient*	*Standard Error*
VOL(–1)	0.013	0.016	0.014	0.016
BEL*GDP	–0.353***	0.129	–0.483***	0.129
GER*GDP	–0.462***	0.147	–0.577***	0.147
UK*GDP	0.117	0.191	0.060	0.183
USA*GDP	2.883***	0.746	0.491	0.609
JAP*GDP	0.231	0.365	0.010	0.314
HK*GDP	4.266***	0.556	3.708***	0.500
CHI*GDP	2.030***	0.185	2.027***	0.185
UK*ER	–1.439***	0.316		
USA*ER	–1.257***	0.358		
JAP*ER	0.159	0.263		
HK*ER	–0.688*	0.364		
CHI*ER	–0.107	0.480		
BDX*UK*ER			–1.145	0.831
BDX*USA*ER			1.081**	0.550
BDX*JAP*ER			1.811***	0.649
BDX*HK*ER			0.039	0.811
BDX*CHI*ER			1.724**	0.869
UK*RP	–0.906***	0.101	–1.046	0.101
USA*RP	–1.004***	0.095	–1.002	0.095
JAP*RP	–1.085***	0.094	–1.087	0.096
HK*RP	–0.855***	0.075	–0.863	0.074
CHI*RP	–0.934***	0.096	–0.939	0.094
BEL*RP	–1.186***	0.124	–1.244	0.125
GER*RP	–1.134***	0.075	–1.166	0.074
Observations	9,936		9,936	
J-statistic	477.81		480.38	
Instrument rank	76		76	

All regressions are run GMM. *** Significance at 1%, ** at 5%, * at 10%. The standard errors are in parentheses. GDP is GDP per capita; ER is exchange rate; RP is relative price; BDX is Bordeaux. BEL is Belgium; GER is Germany; JAP is Japan; HK is Hong Kong; CHI is China.

Note: We cannot interact Belgium and Germany with the exchange rate because they share the same currency with France (euro area).

have an overall negative impact on French exports volume: $\frac{\partial Vol}{\partial ER} = -0.457$ (see Table 4, Model 2). In the long term, the effect of a 1% exchange-rate increase has a significant negative impact on French wines exports volume (–0.571, see Table 4, Model 2). According to the J-curve theory in the dynamics of trade balances the long-term impact is greater than the short-term impact. In the long run, commercial contracts may change and substitute wines may replace less competitive French wines.

The value of the euro, therefore, has had a significant impact on French wine exports volume. For instance, with a long-term coefficient of –0.571 (see Table 4, Model 2), the appreciation of the euro against the GBP and the USD (around

40% and 50%, respectively, over the entire period 2000–2011) may have penalized French wine exports volume on these markets. The exchange-rate effect could explain why there was a 24% decrease by volume in French wine exports volume to the United Kingdom and a 28% decrease in exports volume to the United States over the whole period. Moreover, the average export price of French wines, in euros, relative to the world wine price index provided by OIV (2013) increased by 36.9% between 2000 and 2011. With a relative price elasticity close to –1 (see Table 4, Model 2), this loss of price competitiveness might explain a strong fall of more than one-third in the volumes exported.

Finally, Model 2 could explain why France has experienced such a dramatic fall in its world market share (from 25% to less than 15% from 2000 to 2011) based on exported volume. Meanwhile, Italian market share in volume has remained stable from 2000 to 2011 and Spain exhibited significant gains in volume over the same period. The New World countries have also experienced a rise in their market share in volume. It is unclear, however, to what extent the appreciation of the euro has been responsible for this development. The growing market position of Spanish wines, also using the euro as their currency, suggests that the appreciation of the euro cannot be the sole reason for French wines' competitive deterioration.

Moreover, following Model 2' (Table 4), whatever the considered period, the role of the exchange rate is also ambiguous because we observe strong disparities across the DOs of Bordeaux and Burgundy, and the other DOs of French wine. Table 4's Model 2' shows that wines with the best reputation, such as Burgundy or Bordeaux wines, might be protected against euro appreciations. The exchange-rate elasticity for Burgundy is not significantly different from 0 and is significantly positive for Bordeaux. In contrast, the DOs of French wines as a whole exhibit a significantly negative elasticity. More precisely, for Bordeaux wines, the impact of exchange variations for the period 2000–2011 is $\frac{\partial Vol}{\partial ER} = -0.788 + 1.771 = 0.983 > 0$ (see Table 4, Model 2', T-2000-11). Thus, Bordeaux wines seem to behave like Giffen goods—an appreciation of the euro increases their export volume. In order to test the robustness of Model 2', we divide the entire period into two sub-periods, before the boom in Chinese demand and after; the breakpoint is 2006. We want to know if the boom in Chinese demand is associated with the positive correlation between exchange rate and export volume (i.e., if Chinese demand explains the rise in exports volume despite an appreciation of the euro). The comparison of these two sub-periods exhibits similar results for the exchange-rate variable. The main difference stems from the magnitude of the income elasticity. Unsurprisingly, the period after 2006 is largely determined by foreign incomes on Bordeaux wine export volume. Because Chinese tastes evolved toward red wine, especially Bordeaux red in the middle of the 2000s, the substantial Chinese demand increase, associated with a dramatic rise in revenue, has spurred Bordeaux export volumes.

For all other wines, the exchange rate has a negative and statistically significant impact on exports volume: $\frac{\partial Vol}{\partial ER} = -0.788$. The interaction, however, between

exchange rates and Burgundy is insignificant. How to explain this outcome for Bordeaux wines?

C. *Positive Exchange-Rate Elasticity of Bordeaux Wines*

Two factors may explain the positive elasticity between euro value and Bordeaux wine export volumes. First, Bordeaux wine maybe be a luxury (Giffen) good, which would imply a positive price elasticity for Bordeaux wines. However, Model 2' in Table 4 reports a statistically significant negative price-elasticity for Bordeaux wines. Bordeaux wines as a whole, therefore, cannot be considered as real Giffen goods. Second, importers and/or exporters may have reacted to changing exchange rates by altering the export composition and applied a top-end strategy. If the high end were less price sensitive than wines in lower-priced brackets, such a strategy could be gainful. This compositional effect would imply exporting the best wines and selling the others domestically. This effect is known as quality sorting in international trade where firms choose their quality level to maximize their export revenues (see Crozet, Head, and Mayer 2012).

Unfortunately, without firm-level data we cannot rigorously analyze this hypothesis (Bastos and Silva, 2010). Nevertheless, we propose two ways that may lend support to our hypothesis of compositional variations. First, we interview some of the main French exporters in order to obtain information on their strategic reaction in response to exchange-rate variations. Second, we analyze the average export price since exporting predominantly high-end wines should result in rising export prices. Accordingly, we examine the relationship between exchange rates and export prices.

In France, *négociants* are the main actors in international trade. For instance, in Bordeaux, *négociants* buy the wine from the 6,500 owners constituting the Bordeaux *appellation* (sub-divided into 57 sub-appellations). There are 300 *négociants* operating in Bordeaux (some of them operate in other *appellations* as well), but a few, that is, *Castel*, *Les Grands Chais*, *Philippine de Rothschild*, *Ginestet,* and *CVBG*, are the main actors. Together *Castel* and *Les Grands Chais* have more than 1 billion euros of turnover annually. All five companies manage substantial wine portfolios with several hundreds of wines, including significant global brands such as Dourthe or Mouton-Cadet. Altogether the five companies employ 3,000 people around the world and can adapt their commercial strategy through several channels in response to variations in the euro.

In November 2014, we interviewed two key players among these *négociants*, Alan Sichel, the President of the Bordeaux union of *négociants*[7] and CEO of Maison Sichel,[8] and Mathieu Chadronnier, the CEO of CVBG, one of the biggest

[7] http://www.vins-bordeaux-negoce.com/
[8] http://www.sichel.fr/

négociants in Bordeaux and France (owner of the brand Dourthe).[9] Both provided useful insights into the Bordeaux wine market. First, they confirmed that they do store many different wines and possess large wine portfolios. They then export a large quantity of different wines and also different vintages during the same year. With the exception of Canada (where a state monopoly exists), all exports volume are paid in euros. They did not state how they reacted to euro variations, but they noted a global shift in the demand (from their clients, i.e., importers) from the bottom to the top range during the period we studied. For instance, the proportion of premium wine (more than €11.25 per bottle) exported rose from 32% in 2007 to 62% in 2011 by volume. In contrast, for low-range wines, both Sichel and Chadronnier confirmed a certain sensitivity of exports volume to exchange-rate variations. When the euro rises, importers choose lower-quality wines in order to maintain prices in their own currency. They cite the example of UK retailers who must maintain prices under the threshold of 9.99 GBP for some Bordeaux wines. The adjustment to euro variations, therefore, is made on quality rather than on volume. Nevertheless, these reactions come from importers and not from exporters. In summary, we distinguish two importer reactions to a rising euro value. Some importers may pass on the higher cost in higher prices, while others may keep their prices, but lower quality. The latter appears to apply to Bordeaux wines.

An important observation that both executives shared was that their customers, notably those from China,[10] were generally more sensitive to quality than to prices, especially for premium wines. These customers are already accustomed to seeing high-price variations due to the vintage effect (variations in quality are caused by meteorological conditions during the growing and harvesting seasons). Consequently, the conjunction of rising export volume of Bordeaux wine and a rising euro—the Bordeaux Paradox—would at least partially be due to the very good vintages since 1999. The period we studied was particularly rich in exceptional or very good vintages,[11] which would explain the strong export performance despite the appreciation of the euro. Unfortunately, this vintage effect is impossible to disentangle from our data because *négociants* smooth the sale of a vintage over at least three years.

D. Robustness Check

In this section we test the robustness of the previous results by extending the model to the export value and price and by estimating this model for different type of wine content and destination countries. In Table 5, we extend the analysis to export

[9] http://www.cvbg.com/

[10] There is a coincidence between the Chinese boom for Bordeaux wines, well documented in the media since the mid of the 2000 decade, and the appreciation of the euro against the USD and the GBP.

[11] See for example the vintage guide from R. Parker since 1970 to now https://www.robertparker.com/.

value and price. We also distinguish between bottled and bulk wines. These two forms of packaging correspond roughly to two different quality levels. Bulk wine can be deemed a homogenous commodity while bottled wines are differentiated goods. Table 5 shows that bottled wine export volume and value are negatively impacted by an appreciation of the euro, but bottled wine prices are positively affected. An increase in export prices, therefore, partially compensates the loss in volume. The impact on bottled is more significant than for bulk because bulk wine is a more homogeneous good than bottled wine, therefore, consumers can substitute it more easily. The effect of an appreciation of the euro is very significant on bulk volume, but insignificant on price, suggesting that there is no price-to-market behavior and no effect on margin. In both cases, the long-term effects on volume and value are greater than those in the short term.

For the other variables, that is, the lagged dependent variables, GDP and relative prices, we obtain the expected relations with the expected signs. Export volumes, values, and prices of year t depend positively on export volumes of year $t - 1$ due to the duration of commercial contracts. The impact of GDP is also significant and positive, but it is greater in terms of volume and value, for bottled wine than for bulk volume, assumingly due to the wealth effect. A wealthy consumer may prefer bottles to bulk. Volumes depend negatively on relative price. The impact is greater for bulk than for bottles. Again, due to its easier substitutionability the competition effect appears to be stronger for bulk wine than for bottled wine.

The results reported in Table 6 suggested that French wine export volumes to China and Hong Kong are highly sensitive to the income in these countries while the exports volume to the United Kingdom and the United States are highly sensitive to the exchange-rate variation; note, the largest euro variations have occurred with the United States and the United Kingdom. However, the exports volume to each country are sensitive to the relative prices. Overall, Table 6 supports our results from earlier including the compositional effect. It also shows, however, that some differences exist among the destination markets.

Finally, the Bordeaux Paradox seems to have originated from the importers' strategic response to an exchange-rate rise (i.e., the compositional effect) and the booming Chinese demand for quality wine, specifically Bordeaux wines. Goods with a high reputation appear to be less sensitive to exchange-rate variations, especially when consumers/importers are accustomed to high-price volatility due to the vintage effect. The dramatic rise of the euro, therefore, would not have, or only partially, impeded the exports volume of Bordeaux wines, notably to China.

V. Conclusion

Our analysis suggests that the exchange rate has a strong impact on the French wine trade, especially when reducing the volume exported to the United States and the United Kingdom by about 25%. Exchange rates, however, constitute only one

part of the story; we also have to consider other competitiveness problems, particularly due to high labor cost and land prices.

Nevertheless, higher-quality wines (e.g., Bordeaux or Burgundy) perform well even when overall French wine exports volume are falling. Quality, therefore, partially stymies traditional price competition in the wine sector. In the extreme case of Bordeaux, the leading wine-exporting region in France, the appreciation of the euro is significantly and positively associated with rising exports volume.

Our estimates and interviews would suggest a compositional change in the wines exported toward top-end wines. The Chinese demand for Bordeaux wines may have also played a significant role in the rising trend of Bordeaux exports volume, despite the appreciation of the euro. Employing different tools than Anderson and Wittwer (2013), who draw on a CGEM, our analysis lends support to their main findings, that is, international trade is crucially determined by currency changes and the demand from China.

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