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Drivers of Revealed Comparative Advantage in the Wine Sector

Imre FERTO, Jeremiás BALOGH

University Institute of Economics, Hungarian Academy of Sciences - HU
ferto.imre@krtk.mta.hu, jeremias.balogh@gmail.com

Abstract

The purpose of this research is to provide insight into the export competitiveness of wine of the 38 countries on global markets. Four revealed comparative advantage indices are used to analyze the levels, evolutions in patterns of development in the export competitiveness of wine and their drivers over the analysed years of 2000 to 2013. The revealed comparative advantages on the global markets are the most robust for France Italy, Spain, Chile Australia and United States. Our estimations suggest a divergence in comparative advantage over time at the world market. The results show that GDP and exchange rates have negative effects on the wine export competitiveness, while agricultural employment, grape area harvested and WTO memberships are positively associated with comparative advantages. Our results are relatively robust to alternative revealed comparative advantage indicators.

Keywords: revealed comparative advantage, wine industry, drivers of competitiveness

JEL codes: Q17, F13, F14

1. Introduction

With trade liberalization on global wine markets, the crucial factor for long-term business survival is export competitiveness and its long-term duration, which determines opportunities in the business prosperity of wine products on global markets. On the global wine markets, different countries play the role of global leaders in wine export competitiveness. So far, there has been limited attention to the wine export competitiveness and long-term export specialisation patterns of global wine leaders. Anderson (2013) analyses the Georgian wine industry focusing on the determinants of comparative advantage with revealed comparative advantage index (RCA). He finds three important determinants of a country's comparative advantage in wine production: terroir, tradition, and technology. Anderson and Wittwer (2013) investigate the global wine market to 2018 by considering the impact of real exchange rate changes on competitiveness. They confirm that real exchange rates have played a dominant role in the fortunes of some countries' wine markets in recent years. It suggests that role of China in global wine markets is likely to become increasingly prominent. China has already become the most important wine-consuming country in Asia. Johan van Rooyen et al. (2010) assess competitiveness performance in the wine industry in South Africa using relative trade advantage (RTA) index. They conclude that to competitive in world is to continue to be in a position to trade successfully. Wine sector would be competitive when it is able to continuously trade in global level at qualities and prices that are as good as or better than their competitors. Vlahović et al. (2013) examine the world wine export, the current world trends and explored export structure in the international wine market. They conclude that in the future, a stagnation of international trade can be expected.

The aim of the paper is to examine the pattern and determinants of global wine export competitiveness of major wine exporter countries at the global markets. More specifically, the objective of this paper is to provide empirical evidence and derives explanation on the following research questions. First, we identify the most recent structures and dynamics of wine exports and the magnitude and dynamics of revealed comparative advantage indices by major global competitors. Second, we check the

possible convergence of the revealed comparative advantage indices using panel unit root tests. Finally, we investigate main driving forces of global wine export competiveness using panel models. The econometric models test the set hypotheses and explain the determinants of the comparative advantage considering structural nature and dynamic aspects of an economy, factor endowments in agriculture and policy support.

The paper is organized as follow. In the next section, we explain methods used in empirical analysis. In Section 3, we present and interpret the results of revealed comparative advantage and the regression results. In the final section, we discuss theoretical and empirical contributions, and implications of the results, and conclude the paper.

2. Methodology

2.1. Measuring comparative advantage

Most widely used indicator in empirical trade analysis is based on the concept of revealed comparative advantage (RCA) index, which was developed by Balassa (1965), The Revealed Comparative Advantage (B) index is defined as follows:

$$B = (Xij / Xit) / (Xnj / Xnt) \quad (1)$$

where X represents exports, i is a country, j is a commodity, t is a set of commodities, and n is a set of countries, which are used as the benchmark export markets for comparisons. It measures a country's exports of a commodity relative to its total exports and to the corresponding export performance of a set of countries, e.g., the global agri-food exports. If B > 1, then a country's agri-food comparative export advantage on the global market is revealed.

Despite some critiques of the RCA index as a static export specialization index, such as the asymmetric value problem and the problem with logarithmic transformation (De Benedictis and Tamberi 2004), the importance of the simultaneous consideration of the import side (Vollrath 1991), and the lack of a sound theoretical background (Costinot et al. 2012, Leromain and Orefice 2013), it remains a popular tool for analyzing export competitiveness in empirical trade literature. To check the robustness of our results we apply three additional revealed comparative advantage indices.

Vollrath (1991) offered an alternative specification of revealed comparative advantage, known as the Relative Trade Advantage (RTA), which accounts for exports as well as imports.

$$RTA = B\text{-}RMA \quad (2)$$

$$RMA = (Mij / Mit) / (Mnj / Mnt) \quad (3)$$

where M denotes the imports, i is a country, j is a commodity, t is a set of commodities and n is a set of countries. If RTA>0, then a relative comparative trade advantage is revealed, i.e. a sector in which the country is relatively more competitive in terms of its trade.

To eliminate the problems of asymmetric nature of B index Hoen and Oosterhaven (2006) introduce an additive index of revealed comparative advantage:

$$ARCA = (Xij / Xit) - (Xnj / Xnt). \quad (4)$$

The ARCA index ranges between -1 and +1 with 0 demarcation point.

Yu et al. (2009, 2010) adopted an alternative measure to assess the dynamics of comparative advantage, utilizing the NRCA index to improve certain aspects of original RCA index in static patterns in comparative advantage to be appropriate export specialization index for comparison over space and the changes in comparative advantage and its trends over time. Yu et al. (2009) define the NRCA as follows:

$$NRCA_{ij} = \frac{E_{ij}}{E} - \frac{E_i}{E}\frac{E_j}{E}, \quad (5)$$

where E denotes total world trade, Eij describes country i's actual export of commodity j in the world market, Ei is country i's export of all commodities and Ej denotes export of commodity j by all countries. If NRCA>0, a country's agri-food comparative advantage on the world market is revealed. The distribution of NRCA values is symmetrical, ranging from −1/4 to +1/4 with 0 being the comparative-advantage-neutral point.

2.2. Dynamics of revealed comparative advantages

We focus on the stability of the revealed comparative advantage indices over time. More specifically, we investigate the stability of the distribution of these indices is capturing convergence/divergence in revealed comparative export advantage. Time series investigation of the convergence hypothesis in economic literature often relies on unit root tests. The rejection of the null hypothesis is commonly interpreted as evidence that the time series have converged to their equilibrium state, since any shock that causes deviations from equilibrium eventually drops out. To check convergences or divergence in the revealed comparative advantage indices, three panel unit root tests with and without trend specifications, respectively, as a deterministic component are used: Im et al. (2003) method (assuming individual unit root processes), ADF–Fisher Chi–square, and PP–Fisher Chi–square (Maddala and Wu, 1999; Choi, 2001). In addition, the lag length of explanatory variables has been chosen according to the Modified Akaike Information Criterion (MAIC) proposed by Ng and Perron (2001).

Moreover, in our empirical analysis of convergence the assumption of cross-sectional independence appears to be unreasonable according to the literature, because various studies using cross-country data indicate that time series are contemporaneously correlated (Breitung and Pesaran, 2008). Thus we also investigate the potential for CD in the comparative advantage indices, applying Pesaran (2004) CD test. As it revealed evidence of CD, we used second generation panel unit root test. However, some of the second generation panel unit root tests are require a panel dataset with large time dimension, like Bai and Ng (2004) test. As in our dataset the time dimension is relatively small, we use the Pesaran (2007) test, which perform accurately also with small samples (Moscone and Tosetti, 2009).

2.3. Econometric specifications

The competitive advantage can determine by low-cost labour or access to natural resources (Porter 1998). Each country can gain from trade by exporting products at a lower relative cost as compared to the other country. The lower costs can derive from land intensive or capital-intensive products (Norton et al. 2010). The adoption of labour-saving technology can help poorer countries with rapidly rising real wages retain their comparative advantage in what traditionally had been labour-intensive industries. This means that poorer countries need to find sources of comparative advantage other than just low wages (Anderson, 2013). Some agricultural products are rather land intensive, but wine production inquires capital and skilled labour as well. The role of the agricultural employment is not neglected for wine industry. The competitiveness of wine sector depends on territorial characteristics ranging from natural resources to production factors and techniques (Pappalardo et al. 2013). Anderson (2013) reinforce that there are three important determinants of a country's comparative advantage in wine production such as terroir, tradition, and technology (production factors and techniques).

While trade theory holds that tariff reductions should increase trade flows, the empirical literature on the effects of WTO membership has produced surprisingly ambiguous results. Rose (2004) reports a wide range of empirical specifications that produce no WTO effects. Tomz et al. (2007) use Rose's data but include de facto WTO membership, to find positive WTO trade effects. Eicher and Henn (2011) employ a comprehensive approach that minimizes omitted variable bias to show that all specifications produce one consistent result: WTO effects on trade flows are not statistically significant, while Preferential Trade Agreements produce strong but uneven trade effects.

Based on these studies we focus on four groups of explanatory variables: factor endowment (grape area), economic development factors (GDP, GDP per capita, agricultural employment), real exchange rates and policy variable (WTO membership).

We estimate the following equation:

$$RCA_{it}=\alpha + \beta_1 \ln GDP/capita_{it} + \beta_2 \ln GDP_{it} + \beta_3 agricultural\ employment_{it} + \beta_4 lngrapeland_{it} + \beta_5 lnexchangrate_{it} + \beta_6 WTO_t + u_i + \varepsilon_{it} \quad (6)$$

The indicators of competitiveness are represented by RCA and its additional indices calculated for wine trade. The standard proxy for economic development is the log of GDP per capita at PPP at constant 2005 international $ (lnGDP/capita); market size is measured by log of GDP at PPP at constant 2005 international $ (lnGDP), the employment in agriculture in per cent of total employment (agricultural employment), lnexchangerate denotes the log of the exchange rate between the US dollars and local currencies. These variables for empirical analysis are collected from the World Bank's (2013) World Development Indicator (WDI) database. We employ the log of harvested grape area as a proxy of specific wine production factor endowment (lngrapeland), data are from the FAO database. Finally, we add a dummy to capture of possible impacts of WTO memberships, which takes value one if a particular country is the member of WTO, otherwise zero (WTO).

We apply several estimation techniques to equation (6) in order to ensure the robustness of the results. There are some additional issues that we have to be addressed when are estimated such panel models. First, heteroskedasticity may occur because comparative advantage may be more volatile in small than in large countries. The panel dataset is also subject to the existence of autocorrelation. Contemporaneous correlation across panels may also occur. Preliminary analysis (likelihood ratio tests, Wooldridge test for autocorrelations and Pesaran tests) confirms the presence of heteroscedasticity, autocorrelation and cross-sectional dependence. Because our analysed period is shorter than cross sectional unit, to deal with issues of contemporaneous correlation the panel corrected standard error model (PCSE) is applied which controls for heteroskedasticity and the AR(1) type of autocorrelation and contemporaneous correlation across panels (Beck and Katz, 1995, 1996).

Our balanced panel data set includes 38 wine exporter countries and 14 years (2000-2013) with 532 observations. Wine trade data of analysis is based on World Bank WITS database in HS-6 code1. The all revealed comparative advantage indices are calculated from World Bank World Integrated Trade Solutions (WITS) database wine export and import data, between wine export of a given country and world wine export.

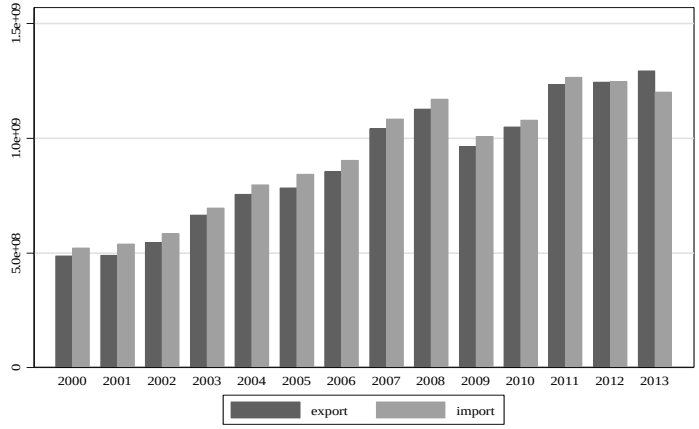
3. Empirical results

3.1. Global wine market leadership

The world wine trade has increased significantly (Figure 1) during analysed period. The value of exports and imports are more than doubled at both markets. We can also observe two important features of the wine trade pattern. First, a rapid growth has occurred in wine trade after the EU enlargement in 2004. Second, there was a considerable drop in 2009 due to global economic crises, and the full recovery of wine trade has already finished in 2011. Interestingly wine imports are declining in the last three years.

[1] product code 2204 - wine of fresh grapes, including fortified wines; grape must other than that of heading

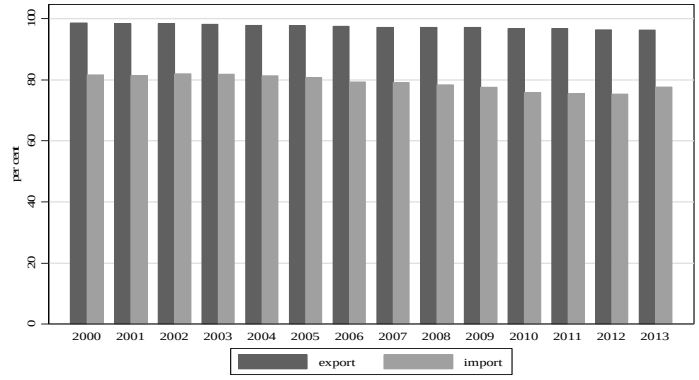
Figure 1: The development of world wine trade (thousand dollars)



Source: Own calculations based on Comtrade database (UNSD 2013) with WITS (World Trade Integration Solution) software (World Bank, 2013a).

The selected countries play a significant role in the world wine trade. The share of sample countries in world export import has been above 90 per cent, while the proportion of imports has varied around 80 per cent with a declining trend after economic crises.

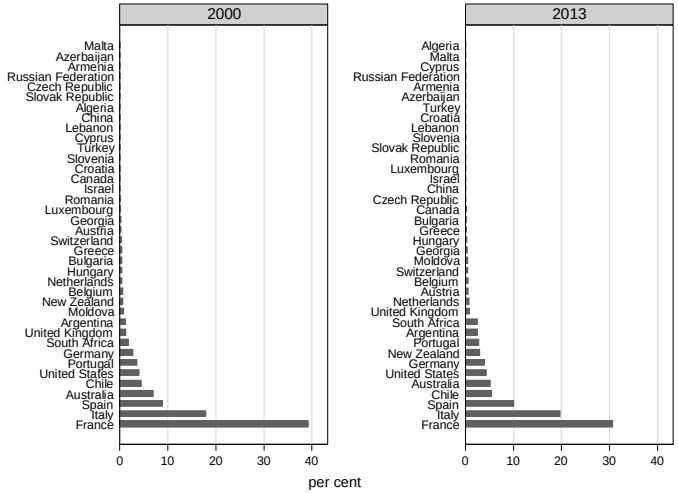
Figure 2: The share of sample countries in the world wine trade



Source: Own calculations based on Comtrade database (UNSD 2013) with WITS (World Trade Integration Solution) software (World Bank, 2013a).

The largest wine exporter countries are France, Italy, Spain, Chile and Australia. The relative position of some countries has changed over time: especially some small European countries could not keep their relative share in the world markets.

Figure 3: The share of sample countries in the world wine trade by countries

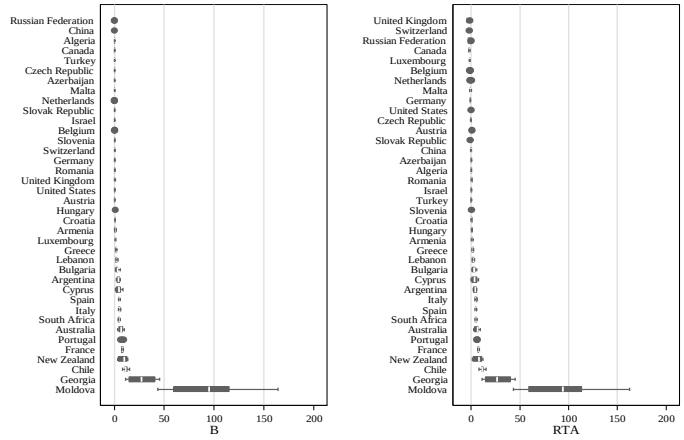


Source: Own calculations based on Comtrade database (UNSD 2013) with WITS (World Trade Integration Solution) software (World Bank, 2013a).

3.2. The pattern of revealed comparative advantage

We find the competitive wine exporters based on different revealed comparative advantage indices in traditional (Italy, France, Spain, Portugal, Greece), in the New World (Argentina, Australia, Chile, New Zealand, South Africa) and in developing (Georgia, Moldova) wine producer countries as well (Figure 3 and 4). The standard deviations are high for Moldova and Georgia in case of B, RTA and ARCA indices but it shows a highest competitiveness. It may be caused by the trade distortion policies. Anderson reinforces Georgia's strong wine export comparative advantage in the past decade. The terroir and tradition of Georgia have been the key domestic influences on its comparative advantage in wine production. By contrast the international competitiveness of its wineries also has been heavily influenced by its long-established trade relations with Russia (Anderson, 2013).

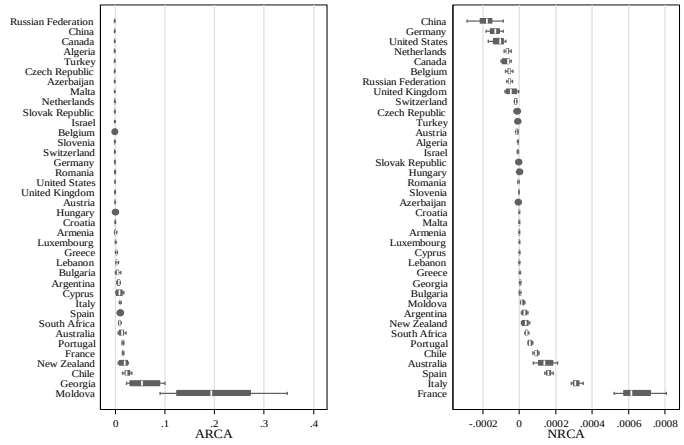
Figure 4: Boxplots for B and RTA indices by country



Source: Own calculations based on Comtrade database (UNSD 2013) with WITS (World Trade Integration Solution) software (World Bank, 2013a).

Based on the boxplot figures of B, RTA and ARCA Georgia, Moldova, Chile are the most competitive wine exporters. The dynamic comparative advantage index (NRCA) rank France, Italy, Spain, Australia and Chile to the first five most competitive wine exporter country. Regarding the comparative disadvantages we find that the lowest wine trade revealed competitiveness indices belong to Russia. Our estimations show that main traditional European and the New World wine exporters are the best performing countries at the world wine market.

Figure 5: Boxplots for ARCA and NRCA indices by country



Source: Own calculations based on Comtrade database (UNSD 2013) with WITS (World Trade Integration Solution) software (World Bank, 2013a).

The general pattern of revealed comparative advantage for the four indices is similar. The usual interpretation of an RCA index is that it identifies the extent to which a country has a comparative (dis)advantage in a product. Ballance et al (1987) offer two other interpretations: that the index provides a ranking of products by degree of comparative advantage; and that the index identifies a binary type demarcation of products based on comparative advantage and comparative disadvantage. Referring to these three interpretations as cardinal, ordinal and dichotomous, they suggest a test of consistency for each.

Table 1: Pairwise correlation coefficients between RCA indices

	RCA	RTA	ARCA	NRCA
RCA	1.0000			
RTA	0.9983	1.0000		
ARCA	0.9973	0.9953	1.0000	
NRCA	0.1083	0.1171	0.1065	1.0000

Source: Own calculations based on World Bank WITS database

The consistency test of the indices as cardinal measures of comparative advantage is based on the correlation coefficient between paired indices in all years (Table 1). Of the six possible pairings, only three (B and RTA, and ARCA) show a high level of correlation (≥0.99). The NRCA indices are weakly correlated to other three indices. This suggests that the indices are not consistent as cardinal measures of comparative advantage

The consistency test of the indices as ordinal measures is similar, but based on the rank correlation coefficient for each pairing (Table 2). Results show that the indices are strongly consistent in ranking product groups by revealed comparative advantage, with correlation coefficients being > 0.82.

Table 2: Spearman rank correlation indices between RCA indices

	RCA	RTA	ARCA	NRCA
RCA	1.0000			
RTA	0.8116	1.0000		
ARCA	0.9886	0.8060	1.0000	
NRCA	0.8246	0.8414	0.8213	1.0000

Source: Own calculations based on World Bank WITS database

The test of the indices as a dichotomous measure is simply the share of product groups in which both of the paired indices suggest comparative advantage or comparative disadvantage. The RCA, ARCA, and NRCA indices are fully consistent. The RTA indices are also reasonable consistent with share being > 0.79.

These simple tests shed light on the sensitivity of any conclusions based on the RCA indices. They confirm that the indices are less consistent as cardinal measures, in accord with the findings of Ballance et

al (1987) and Fertő and Hubbard (2003). However, the test results offer more support for use of the indices as an ordinal or binary measure of comparative advantage. Accordingly, we conclude that our RCA measures are useful proxies in determining whether or not a country has a comparative advantage in wine, though less useful in indicating the extent of any comparative advantage.

3.3. Dynamics of revealed comparative advantage

To investigate convergence vis-à-vis divergence in the dynamics of the comparative advantage indices, panel unit root tests with time-trend and without time-trend specifications, respectively, as a deterministic component are used (Table 3). The empirical results of the three different panel unit root tests with and without time-trend provide strong support the existence of the panel unit root hypothesis for all indices, except PP tests with time trend for B index. This implies that the comparative advantage indices are non stationary rejecting the hypothesis of convergence in the dynamics of the comparative advantages.

Table 3: Panel unit root tests for the revealed comparative advantage indices, 2000-2013 (p-values).

	without trend			with trend		
	IPS	ADF	PP	IPS	ADF	PP
RCA	0.8277	0.4140	0.0648	0.5152	0.4051	0.0053
RTA	0.9139	0.7599	0.0876	0.9856	0.7940	0.0632
ARCA	0.8099	0.9362	0.6317	0.3112	0.5200	0.0650
NRCA	0.7871	0.8142	0.7177	0.3712	0.4583	0.1796

Note: IPS (Im, Pesaran and Shin W-stat), ADF (ADF - Fisher Chi-square), PP (PP - Fisher Chi-square).
Source: Own calculations based on Comtrade database (UNSD 2013) with WITS (World Trade Integration Solution) software (World Bank, 2013a).

Table 4: Cross-sectional dependence (CD) tests

Variable	CD-test	p-value
RCA	1.48	0.140
RTA	4.73	0.000
ARCA	7.62	0.000
NRCA	0.62	0.534

Source: Own calculations based on Comtrade database (UNSD 2013) with WITS (World Trade Integration Solution) software (World Bank, 2013a).

We test also the cross-sectional dependence in various comparative advantage indices. Our estimations show mixed results (Table 4). For the RCA and NRCA indices we cannot reject hypothesis of cross-sectional independence, while tests provide evidence of cross-sectional dependence for the RTA and ARCA indices.

Finally, we apply Pesaran (2007) panel unit root tests to take into account the impacts of cross-sectional dependence employing 0-2 years lags. Our estimations reinforce previous results, namely we find strong evidence for the existence of panel unit root in all comparative advantage indices. In other words, RCA indices are diverging over time.

Table 5: Pesaran (2007) panel unit root tests (p values)

	without trend			with trend		
lags	0	1	2	0	1	2
RCA	0.995	0.948	1.000	0.935	0.994	0.988
RTA	0.995	0.948	1.000	1.000	1.000	1.000
ARCA	0.517	0.010	0.166	0.981	0.767	0.966
NRCA	0.917	0.823	0.989	0.977	0.934	1.000

Source: Own calculations based on Comtrade database (UNSD 2013) with WITS (World Trade Integration Solution) software (World Bank, 2013a).

3.4. Regression results

The estimations show that the wine exports are negatively associated with the economic size of the country in terms of GDP for each of comparative advantage indices (Table 5). The agricultural employment positively influence wine exports, except NRCA specification. The harvested grape areas increase exports for all models. The exchange rate has significant negative impacts on wine exports. Our results support the argument of Anderson and Wittwer (2013) that the exchange rates play a dominant role on wine market and justify that factor endowment such as grape land and agricultural employment are important determinants of a country's comparative advantage of wine trade. Finally, in line with theoretical expectation WTO membership is positively associated with the exports, except NRCA model. The economic development has no significant effects except NRCA index. In sum, our results are strongly robust to three indicators (B, RTA, ARCA), while robustness of estimations is moderate for NRCA index.

Table 5: Regression results

	RCA	RTA	ARCA	NRCA
lnGDP/capita	0.053	-0.390	0.000	0.203***
lnGDP	-2.612***	-2.428***	-0.005***	-0.173***
agricultural employment	0.414***	0.412***	0.001***	-0.017***
lngrapeland	1.333***	1.335***	0.003***	0.245***
lnxrate	-0.245*	-0.263**	-0.001**	-0.030***
WTO membership	12.830***	12.595***	0.027***	-0.063
constant	41.851*	40.872*	0.081*	0.489
N	532	532	532	532
R^2	0.237	0.248	0.206	0.185
legend: *** p<0.01, ** p<0.05, * p<0.1				

Source: Own calculations

4. Conclusions

This paper provides new evidence on wine export competitiveness of the 38 countries over the analysed years (2000–2013). We evaluated competitiveness of wine export employing four revealed comparative advantage indices (RCA, RTA, ARCA, NRCA). Our estimations imply that besides traditional (Italy, France, Spain, Portugal, Greece), and the New World (Argentina, Australia, Chile, New Zealand, South Africa) Georgia and Moldova exhibit a strong comparative advantage in the wine. Consistency tests confirm that applied trade indices perform very well in terms of binary and ordinal measures, while they work less efficient as a cardinal indicator. The panel unit root tests provide a strong support the existence of panel unit root indicating a divergence in comparative advantage at the world markets. Econometric estimations show that GDP and exchange rates negatively influence revealed comparative advantages, while agricultural employment, grape area harvested and WTO memberships have positive impacts on the wine export competitiveness. However our study also has several restrictions. First, our results are measured at the macro level and do not take into account the quality of wine product. Our models assume that wine products across countries are homogenous goods and do not consider further factors on the demand side of wine trade. Additional research is also needed for better understanding the drivers of competitiveness especially at farm levels.

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Appendix 1: List of wine exporter countries in the sample

Algeria	China	Italy	Slovak Republic
Argentina	Croatia	Lebanon	Slovenia
Armenia	Cyprus	Luxembourg	South Africa
Australia	Czech Republic	Malta	Spain
Austria	France	Moldova	Switzerland
Azerbaijan	Georgia	Netherlands	Turkey
Belgium	Germany	New Zealand	United Kingdom
Bulgaria	Greece	Portugal	United States
Canada	Hungary	Romania	
Chile	Israel	Russian Federation	

Appendix 2: Descriptive statistics of the variables

Variable	Obs	Mean	Std. Dev.	Min	Max
RCA	532	5.283597	16.35765	.0022554	164.2053
RTA	523	4.52324	16.51564	-4.423891	162.536
ARCA	532	.0092383	.0357893	-.002456	.3470109
NRCA	532	.0000189	.0001309	-.0002876	.0008055
lnGDP	532	25.89943	1.989404	20.97636	30.4524
lnGDPpercapita	532	9.463008	1.174048	5.8693	11.62651
Employmentinagr	445	11.83191	13.91319	0.6	55.3
lngrapeland	532	10.42467	2.40326	2.197225	13.98619
lnxrate	532	1.488969	2.553006	-.6937473	10.45354
WTOmembership	532	.8947368	.307181	0	1

Appendix 3: Pearson's correlation between analysed variables

	RCA	RTA	ARCA	NRCA	lnGDP	lnGDPpc	Empinagr	lngrapeland	lnxr
RCA	1.0000								
RTA	0.9983*	1.0000							
ARCA	0.9973*	0.9953*	1.0000						
NRCA	0.1083*	0.1171*	0.1065*	1.0000					
lnGDP	-0.3607*	-0.3781*	-0.3610*	0.0820	1.0000				
lnGDPpc	-0.4053*	-0.4339*	-0.4074*	0.1329*	0.5636*	1.0000			
Empinagr	0.3863*	0.4049*	0.3904*	-0.1484*	-0.4026*	-0.7952*	1.0000		
lngrapeland	0.1677*	0.1951*	0.1650*	0.3624*	0.2328*	-0.2548*	0.2445*	1.0000	
lnxr	0.0472	0.0651	0.0474	-0.0886*	-0.2757*	-0.4912*	0.3862*	0.1685*	1.0000
WTO	0.0963*	0.0826	0.0947*	0.0585	0.2151*	0.3389*	-0.3961*	-0.0060	-0.5305*

legend: * $p<0.05$