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The impact of COVID-19 government policy on the international wine trade

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Abstract
To control the health impact of the COVID-19 pandemic, governments implemented various restrictive policies, such as stay-at-home orders and restrictions on internal movement, which had adverse effects on consumption and, consequently, on international trade. This was observed even for products intensively traded and minimally impacted in terms of production, such as wine. Thus, to work towards a better awareness of future crises, this study assesses the impact of government policy responses to COVID-19 on the international wine trade. A gravity model, a benchmark approach for studying the determinants of trade, is estimated using monthly data for 20 exporting countries and 214 potential importing countries. The findings suggest that, ceteris paribus, the value of wine export flows was inversely related to the intensity of government policy response in importing countries due to lower demand provoked by restrictive measures. This effect was considerably reduced, however, concerning wines coming from the Old World, which are inferred to be more resilient, a factor primarily attributed to their higher share of wines exported with geographical indications. On the other hand, only the exports from Old World countries were negatively influenced by restrictions on internal movements in the exporting country, which reflects a business model with a complex supply chain in which several intermediaries are involved, thus weakening the direct linkage between wine producers and consumers.

Keywords: Gravity model, Lockdown, Pandemic crisis, Spillover effect

Introduction
In many industries, both supply and demand were impacted by government policies to fight the pandemic of COVID-19. However, for some products, such as wine, their long-term storability and the exemptions regarding labour movements allowed production to continue almost unaffected. On the other hand, there have been consequences on income and consumption habits, and wine consumption was also impacted by containment measures, in particular, due to the closure of restaurants and bars, the limitations imposed on celebrations, and the huge decline in international travel (Wittwer and Anderson 2021). There is extensive academic literature that analyses how wine consumption habits and purchasing patterns have been impacted by COVID-19 and government policies to contain it (Compés et al. 2021; Davids et al. 2022; Duarte Alonso

et al. 2022; Dubois et al. 2021; Gastaldello et al. 2022; Miftari et al. 2021; Rebelo et al. 2021; Wittwer and Anderson 2021). Additionally, considerable attention has been paid to the impact of the pandemic on wine tourism (Eastham 2022; Fountain et al. 2022; Gastaldello et al. 2022; Guedes et al. 2022) and, to a lesser extent, on wine producers (Britta et al. 2022; Davids et al. 2022; Wittwer and Anderson 2021).

However, research analysing the impact on international trade is still scarce (Britta et al. 2022; Davids et al. 2022; Wittwer and Anderson 2021). The article of Wittwer and Anderson (2021) is an exception, as they used the International Monetary Fund's macroeconomic growth rate projections of October 2020 to apply a global economic model to simulate the progress of wine, beer, and spirits markets.[1] In terms of the real value of wine exports and comparing with a no-COVID baseline, they estimated a decrease in the entire world of 15% in 2020 and 9% in 2021. A large share of this decrease was attributed to changes in sparkling wine exports in 2020 (−47%), although they estimated a partial recovery for 2021 (−15%). In fact, it can now be observed that these projections were pessimistic, as the wine trade did not decrease as much in 2020 and, more importantly, recovered its growth in 2021. Based on Comtrade data, wine trade nominal value decreased 4.5% in 2020 and increased 15.2% in 2021, while trade value of sparkling wine decreased 13.4% in 2020 and increased 37.8% in 2021.

Given the aforementioned potential constraints on global trade flows of wine and to foresee future crises, it is crucial to inquire into the following issues, which frame two main research questions: (RQ1) Have government policy responses to COVID-19 in exporting countries had any impact on the international wine trade? (RQ2) Have government policy responses to COVID-19 in importing countries had any impact on the international wine trade?

Then, following the literature (Britta et al. 2022; Dubois et al. 2021; Wittwer and Anderson 2021), we raise a subsidiary and third research question: (RQ3) If government policy responses to COVID-19 had an impact on the international wine trade, does it vary according to whether the exporting country is from Old or New World? It is common to differentiate Old World (e.g. France, Italy, Portugal) and New World (e.g. Australia, South Africa, the USA) wine producers due to their historical traditions (Old World countries have been producing wine for centuries, while in the New World it emerged in the second half of the twentieth century), rules and regulations (e.g. yield constraints imposed by appellation regimes), industrial organisation (e.g. distribution in the New World tend to be less complex with large intermediate bodies), and marketing strategies (e.g. the Old World relies more on appellations, while the New World focuses more on the development of strong brands) (Ugaglia 2019; Ugaglia et al. 2019). In the European Union (EU), where most of the Old World wine-producing countries are located, the European Commission (EC) announced as early as spring 2020 that containment measures would reduce wine consumption by 8% compared to the last 5-year average, even after taking into account an increase in retail sales (European Commission 2020). However, changes in consumption are likely to vary across countries, as Dubois

[1] Among their assumptions are a "Nike tick" economic recovery, constant exchanges rates and overall price index, and a swing away of 30% from sparkling wine (due to restrictions on gatherings) benefiting super-premium wines by 5% in 2020.

et al. (2021) pointed out that in Spain, France, Italy, and Portugal, the group whose wine consumption increased or remained constant was greater than that among whom wine consumption was reduced during the first lockdown. Moreover, Britta et al. (2022) analysed surveys collected from wineries in different countries, leading to the conclusion that Old World countries were more impacted by COVID-19 in terms of international market access. Britta et al. (2022) argue that this is due to the relatively greater importance of the exports value for the business model adopted in these countries, in particular for those they call "historic countries" (France, Italy, and Spain), which face a complex supply chain entailing longer distances from wine producers to consumers. Ugaglia (2019) explains that the high diversity of actors in the wine industry of the Old World, including, for example, cooperatives, merchants, and wholesalers, leads to longer chains (compared to the New World) and excessive fragmentation, which hinders the emergence of very large companies capable of competing through volume.

To answer our three research questions, this study estimates a gravity model through Poisson pseudo-maximum likelihood (PPML) for monthly wine exports from 20 main exporting countries to 214 potential importing countries, from January 2018 to August 2022. The focus is on the impact of government responses to the COVID-19 pandemic, measured through four indices from the Oxford COVID-19 Government Response Tracker (Hale et al. 2021), which can measure the global response or specific dimensions such as containment and health, stringency, and economic support.

Therefore, despite the existence of a vast set of research investigating the impact of COVID-19 on international trade (Barbero et al. 2021; Hayakawa and Mukunoki 2021; Masood et al. 2022) and to the wine industry, limited attention has been paid to the impact of the COVID-19 pandemic specifically on the wine trade. Notably, no gravity model has been estimated, even given that it is the benchmark methodology for studying trade determinants (Head and Mayer 2014). This research aims to address this gap and also contributes to the literature by adopting a recent trend in gravity models, using monthly data to analyse the short-run impact of rapidly occurring shocks (Barbero et al. 2021).

The remaining part of this paper is structured as follows. The next section "Materials and methods" describes the data used and presents our gravity equations. The following section "Results and discussion" provides the empirical estimations and discusses the findings. Finally, the main conclusions are presented in the last section.

Materials and methods

Data

To estimate the impact of COVID-19 government policy on wine exports (Harmonised System code 2204), this study focuses on 20 main wine-exporting countries[2] and 214 potential importing countries. The period under study starts in January 2018 for all exporting countries and ends no later than August 2022.[3] Export data were extracted

[2] The top 20 wine exporting countries were defined by adding up wine exports by value for the period 2017–2021.

[3] The last observation has a different date of 2022 for each exporting country, depending on data availability: August for South Africa and Georgia; July for UK, Lithuania, Denmark, Hong Kong, USA, Spain, Portugal, New Zealand, Germany, Chile, and Australia; June for Argentina, Italy, the Netherlands, France, and Austria; and March for China). For Singapore we have data for a shorter time period (until June 2021), but econometric estimations excluding this country do not significantly change the conclusions. Results available upon request.

Table 1 Wine exports of 20 main wine exporting countries from 2018 to 2021 and their weight in the global wine trade. *Source*: Own computation based on data from Comtrade

	2018		2019		2020		2021	
Country	**Million US$**	**%**	**Million US$**	**%**	**Million US$**	**%**	**Million US$**	**%**
France	11,056	29	10,968	31	9975	29	13,082	32
Italy	7370	20	7200	20	7227	21	8413	20
Spain	3514	9	3067	9	3060	9	3481	8
New Zealand	1202	3	1230	3	1306	4	2301	6
Chile	1999	5	1930	5	1822	5	1970	5
Australia	2160	6	2054	6	2037	6	1606	4
USA	1448	4	1385	4	1312	4	1454	4
Germany	1235	3	1181	3	1056	3	1189	3
Portugal	1015	3	917	3	979	3	1097	3
Argentina	820	2	793	2	776	2	828	2
South Africa	781	2	661	2	623	2	751	2
UK	825	2	838	2	674	2	642	2
Singapore	504	1	518	1	368	1	596	1
Netherlands	380	1	348	1	441	1	592	1
Austria	217	1	217	1	227	1	277	1
Georgia	197	1	223	1	210	1	239	1
Hong Kong	437	1	193	1	116	0	205	0
China	365	1	83	0	26	0	82	0
Sample	35,524	95	33,806	94	32,233	94	38,807	94
World	37,577	100	35,791	100	34,168	100	41,277	100

"%" refers to the share of world wine exports

from the Comtrade database for most countries, except for France and Austria whose data come from the Comext database.[4] Table 1 presents the evolution of wine exports, in value, for the countries in our sample during the period under study, showing also that they represent around 94% of total exports in value.[5]

Data for geographical distance, language, colonial linkages, and contiguity were collected from the CEPII Gravity dataset, while the grouping of exporting countries between the Old World (France, Italy, Spain, Portugal, Germany, and Austria), New World (Argentina, Australia, Chile, New Zealand, the USA, South Africa, China, and Georgia) or others was based on Ugaglia et al. (2019).[6] Countries in the category of "others" such as Denmark, Hong Kong, Lithuania, the Netherlands, and Singapore are not typical wine producers and frequently act as re-exporters.

The indices measuring government response to the COVID-19 pandemic come from the Oxford COVID-19 Government Response Tracker (Hale et al. 2021), which represents one of the foremost approaches for measuring countries' policy responses (Barbero

[4] From 2021 onwards, data for South Africa have been complemented using the South African Revenue Service database (https://www.sars.gov.za/). Furthermore, exports of wine were prohibited for three weeks of 2020 (Davids et al. 2022). We therefore chose to perform a robustness check by excluding South Africa from the estimations, which led to similar results (available upon request).

[5] Exports in 2022 are not considered in Table 1 because the time series available are not the same for every country and to avoid possible seasonality concerns.

[6] We merged the New New World group highlighted by Ugaglia et al. (2019) with the New World because there were only two countries from the former group in the top 20 (China and Georgia). Also, Austria is classified as a country from the Old World based on Storchmann (2018).

Overall government response	*Containment and health*	*Stringency*	C1: School closures
			C2: Workplace closing
			C3: Cancel public events
			C4: Restrictions on gatherings
			C5: Public transportation
			C6: Stay-at-home order
			C7: Restrictions on internal movement
			C8: International travel controls
			H1: Public information campaigns
			H2: Testing policy
			H3: Contact tracing
			H6: Facial coverings
			H7: Vaccination policy
			H8: Protection of elderly people
		Economic support	E1: Income support
			E2: Debt/contract relief for households

Fig. 1 Indices measuring government response to the COVID-19 pandemic and their composing indicators. *Notes*: Indicators of containment and closure policies are denoted with a code starting with "C", those for the health system start with "H", and those for economic support policies start with an "E"; the stringency index is contained in the containment and health index, while all indices are contained in the overall government response index. *Source*: Oxford COVID-19 Government Response Tracker

et al. 2021; Hayakawa and Mukunoki 2021).[7] These indices are computed based on several indicators (measured using an ordinal scale) and they measure the intensity of economic (e.g. debt/contract relief for households), health system (e.g. contact tracing), and containment and closure policies (e.g. stay-at-home order). Four indices will be considered, namely the overall government response index (OGR), the containment and health index (C&H), the stringency index (STR), and the economic support index (ECO). The C&H focus on health systems and containment and closure policies, the STR on containment and closure policies and an indicator for public information campaigns, and ECO only considers policies for economic support. The OGR encompasses the previous indices and the indicators composing each index are presented in Fig. 1. The source presents daily data, so, as Barbero et al. (2021) did, we had to calculate the average values to perform our monthly analysis.

Figure 2 clearly shows that most countries only began responding to the pandemic in March 2020, with the maximum worldwide OGR of 62 being reached as early as April 2020. Then, the average index remained above 50 until 2022, when it started to decline steadily. Both groups of countries from the New and Old World presented an average OGR always superior to the world mean. However, in the New World countries present in our sample the evolution was almost parallel to that of the world as a whole while in the Old World countries, the peak of the OGR was instead attained in the first quarter of 2021. The descriptive statistics for all variables are available in Table 4 of Appendix.

Gravity equations

To fulfil the research questions, this study considers a gravity model augmented with indices of governments' responses to COVID-19. This methodology is widely recognised

[7] Detailed explanation of these indices is also available on their website (https://github.com/OxCGRT/covid-policy-tracker). The source computes different versions of the indices and in the present study we consider the versions that (i) weight the vaccine-differentiated policies by the proportion of the population that are fully vaccinated (*WeightedAverage*) and (ii) handle gaps in data by extrapolating the index to smooth over the last seven days where there is incomplete data (*ForDisplay*).

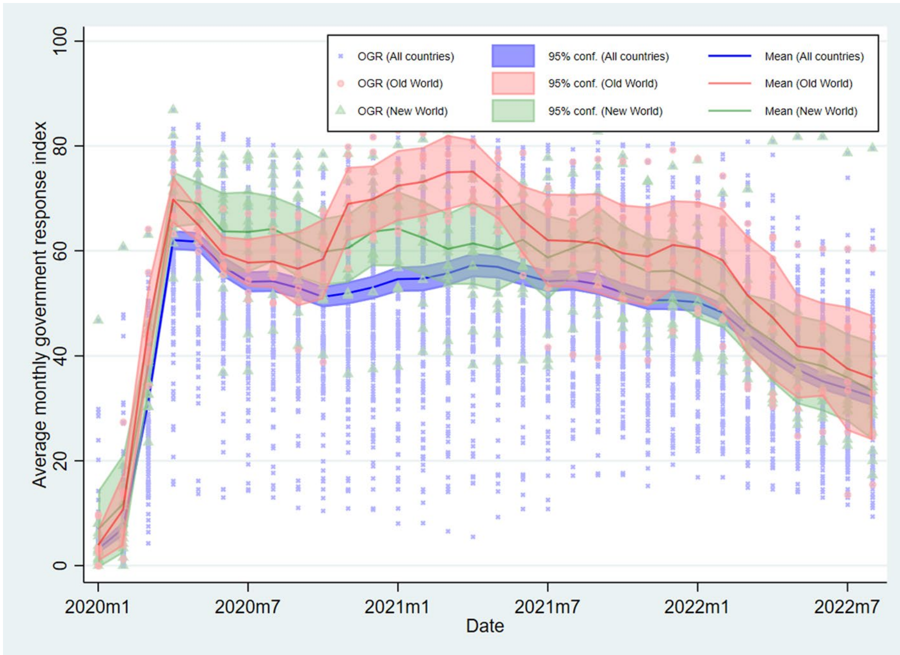

Fig. 2 Overall government response index (OGR), comparing Old and New World wine-producing countries. Note: "95% conf." represents the 95% confidence bands for each series. *Source*: Own computation based on data from the Oxford COVID-19 Government Response Tracker

as a benchmark to analyse the trade determinants (Head and Mayer 2014) and, in exponential functional form, the gravity equation could be presented as follows (Barbero et al. 2021):

$$\begin{aligned}\text{Exports}_{ijm} = \exp\Big(&\beta_0 + \beta_1 \log\ \text{Dist}_{ij} + \beta_2\text{Comlang}_{ij} + \beta_3\text{Colony}_{ij} + \beta_4\text{Contig}_{ij} \\ &+\beta_5 \log\ \text{GR}_{im} + \beta_6 \log\ \text{GR}_{jm} + \mu_i + \vartheta_j + \delta_m\Big) \times \varepsilon_{ijm}\end{aligned} \tag{1}$$

where the subscripts i, j, and m are used, respectively, to refer to exporting countries, importing countries, and the month. Several variables relating to countries i and j and which are typically used in gravity equations are included (Head and Mayer 2014), such as the geographical distance (Dist_{ij}), a dummy variable for countries with a common language (Comlang_{ij}), a dummy variable for countries sharing past colonial linkages (Colony_{ij}), and a dummy variable for adjacent countries (Contig_{ij}). The impact on the wine trade provoked by government responses to the COVID-19 pandemic is measured through four different indices for exporting (GR_i) and importing countries (GR_j), allowing us to reply to RQ1 and RQ2, respectively. In addition, the equation includes controls for importer (ϑ_j), exporter (μ_i), and time (δ_m) fixed effects, as well as an error term (ε_{ijm}).

The equation is estimated through PPML, widely used in the literature as it allows us to avoid the "zero problem" of gravity equations (Macedo et al. 2020b). While the equation considers exporter, importer, and time fixed effects separately, we cannot include in the equation exporter-month and importer-month fixed effects to entirely comply with multilateral resistance terms (Head and Mayer 2014), as they would be perfectly collinear with GR and would not allow us to measure the impact of government responses to COVID-19 on the wine trade. Also, unlike the procedure suggested in typical gravity models (Head and Mayer 2014), the gross domestic product was omitted from the equation because it is usually measured quarterly or yearly.

Variations of Eq. 1 will be considered to test the impact of government responses on exports one and two months later (Eq. 2), or to evaluate whether the impact of government responses was different when the exporting country was an Old or New World wine-producing country (Eq. 3), helping us to address RQ3. The former analysis is based on the estimation of coefficients for the lagged-variable of GR_{jm},[8] while the latter is conducted by interacting GR_{im} and GR_{jm} to a categorical variable equal to two when the exporting country belongs to the Old World, equal to one when it is a New World country, and equal to zero otherwise.

$$\begin{aligned} Exports_{ijm} = \exp \Big(& \beta_0 + \beta_1 \log \text{ Dist}_{ij} + \beta_2 \text{Comlang}_{ij} + \beta_3 \text{Colony}_{ij} + \beta_4 \text{Contig}_{ij} + \beta_5 \log \text{ GR}_{im} \\ & + \beta_6 \log \text{ GR}_{jm} + \beta_7 \log \text{ GR}_{j,m-1} + \beta_8 \log \text{ GR}_{j,m-2} + \mu_i + \vartheta_j + \delta_m \Big) \times \varepsilon_{ijm} \end{aligned} \tag{2}$$

$$\begin{aligned} \text{Exports}_{ijm} = \exp \Big(& \beta_0 + \beta_1 \log \text{ Dist}_{ij} + \beta_2 \text{Comlang}_{ij} + \beta_3 \text{Colony}_{ij} + \beta_4 \text{Contig}_{ij} \\ & + \beta_5 \log \text{ GR}_{im} * \text{OldNew}_i + \beta_6 \log \text{ GR}_{jm} * \text{OldNew}_i + \mu_i + \vartheta_j + \delta_m \Big) \times \varepsilon_{ijm} \end{aligned} \tag{3}$$

Results and discussion

This section presents the main results on the impact of government policy responses to COVID-19 on the international wine trade, which were derived from the estimation of Eqs. 1–3 through PPML. The results for each equation are presented in Table 2,[9] where it can be seen that for Eq. 3 the OGR of exporting countries was substituted by two indicators of containment and closure policies.[10] The heteroskedasticity-robust RESET test suggests the rejection of the null-hypothesis of misspecification in the three estimations.

Starting with the results concerning the OGR index in exporting countries, it can be observed that the estimated coefficients are not statistically significant, which answers RQ1 by suggesting that government policy responses to COVID-19 in exporting countries had no impact on the international wine trade. This is an unsurprising result considering that the index is composed of 16 indicators and several of them are expected to influence wine demand (measured by the OGR in the importing country) more than supply. Indeed, Wittwer and Anderson (2021) suggest low impact on wine production, as several exceptions were made for labour movements, and one should also take into account that wine is a long-term storage product.

[8] A three-month lagged variable of GR_{jm} was not included because the estimated coefficient was not statistically significant. For a similar reason, no lag of GR_{im} was considered and, as it will be observed in the results and discussion section, the estimated coefficient in m is already not statistically significant.

[9] Additionally, in Appendix Table 5 the results of estimating Eq. 1 are presented while controlling for exporter-month and importer-month fixed effects (column i) and the results of estimating Eqs. 1 and 2 while controlling for country-pair and time fixed effects (respectively, columns ii and iii). These are only complementary analyses because estimations controlling for exporter-month and importer-month fixed effects do not allow for studying the impact of OGR, our key variable, and because controlling for country-pair fixed effects reduces the sample considerably (all bilateral relationships with zero trade during the whole period of study are dropped out).

[10] Out of the 16 indicators composing the OGR, only two are considered because (i) exporting country policies related to household economic support and the health system are not expected to influence wine supply (that is why the OGR is never statistically significant) and (ii) the indicators for containment and closure policies are highly correlated, so we restrict ourselves to two theoretically more likely to influence wine exports.

Table 2 Results of the PPML estimations considering the impact of the OGR on wine exports

Variables	Equation 1	Equation 2	Equation 3
log Dist	−0.457***	−0.458***	−0.457***
	(0.084)	(0.084)	(0.084)
Comlang	0.742***	0.740***	0.744***
	(0.177)	(0.177)	(0.177)
Colony	0.296	0.301	0.295
	(0.514)	(0.512)	(0.514)
Contig	0.292	0.282	0.291
	(0.298)	(0.298)	(0.298)
$\log(OGR+1)_{importer,t}$	−0.132***	−0.070***	
	(0.038)	(0.026)	
$\log(OGR+1)_{importer,t-1}$		−0.069***	
		(0.022)	
$\log(OGR+1)_{importer,t-2}$		−0.068***	
		(0.026)	
$\log(OGR+1)_{importer,t} * OldNew_{exporter}$			
Exporter: Old World			−0.102***
			(0.034)
Exporter: New World			−0.180***
			(0.041)
Exporter: Other			−0.144***
			(0.041)
$\log(OGR+1)_{exporter,t}$	0.010	0.006	
	(0.030)	(0.029)	
$\log(StayAtHome+1)_{exporter,t}$			
Exporter: Old World			0.018
			(0.025)
Exporter: New World			0.012
			(0.082)
Exporter: Other			−0.019
			(0.121)
$\log(InternalMove+1)_{exporter,t}$			
Exporter: Old World			−0.080**
			(0.035)
Exporter: New World			−0.080
			(0.095)
Exporter: Other			−0.028
			(0.083)
Constant	20.143***	20.328***	20.167***
	(0.699)	(0.714)	(0.722)
Exporter controls	Yes	Yes	Yes
Importer controls	Yes	Yes	Yes
Time controls	Yes	Yes	Yes
N	206,097	197,539	206,097
pseudo-R^2	0.892	0.893	0.893
RESET	7.80***	10.36***	10.07***

Robust standard errors in parentheses

OGR = Overall government response index

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

Conversely, OGR in the importing country has a negative and significant impact on the wine trade.[11] Addressing RQ2, this means that government policy responses to COVID-19 in importing countries (e.g. stay-at-home orders and the cancellation of public events) constrained the demand for imported wines and, consequently, the international wine trade. Using lagged indices, it is observed that the negative effect of these policies was not limited to the month in which they were taken, but also affected the following two months.

The findings of Eq. 3 highlight a significant impact of OGR in importing countries, regardless of the type of wine exporting country. To tackle RQ3, i.e. to identify whether the impact of OGR in importing countries is the same for Old World and New World exporting countries, the equality of coefficients was tested, and the results suggest they are different ($chi^2 = 21.18$, p-value = 0.00).[12] Specifically, a lower impact of the OGR in the importing country is estimated on demand for wines coming from Old World countries. This might be the result of better resilience of wines with geographical indication, which represent a higher share of production in the Old World, because they are, consequently, less substitutable (Macedo et al. 2020a, 2020b).[13]

Moreover, when analysing specific policies taken by exporting countries, although a significant impact of stay-at-home orders is still not observed, it should be noted that the restrictions on internal movements posed a significant barrier to trade when the exporting country was from the Old World. This finding is in line with the conclusions of Britta et al. (2022), which suggest that the impact on international market access was stronger for Old World countries due to a business model based on a more extensive and complex supply chain than in the New World.

The remaining explanatory variables are typical of gravity equations, with statistically significant coefficients estimated for distance and common language, but not for contiguity and past colonial linkages.[14] As expected, geographical distance has a negative effect, while sharing the same official language has a positive impact. These results converge with several studies (Macedo et al. 2019; Castillo et al. 2016; Dal Bianco et al. 2016; Lombardi et al. 2016).

As a complementary analysis, in Table 3 the results of estimating Eqs. 1 and 2 are present but substituting the OGR by the C&H (columns i and ii), the STR (columns iii and iv), and the ECO (columns v and vi). This allows us to determine which groups of government policies had more impact on wine exports.[15]

The results using the C&H and the STR are very similar to the ones previously presented for the OGR. However, the ECO of exporting and importing countries do not have a significant impact on wine exports. The ECO is composed of an indicator for income support and another for debt/contract relief for households, so these seem to be government policies with no impact on the wine trade in the short term. On the other

[11] Estimations controlling for country-pair and time fixed effects (columns *ii* and *iii* of Appendix Table 5) lead to similar results concerning the impact of OGR in exporting and importing countries.

[12] The impact of OGR in importing countries is also different at 10% of significance level for Old World exporting countries and Other exporting countries ($chi^2 = 3.51$, p-value = 0.06).

[13] The countries in the category Others are mainly re-exporters, for wines coming from both New and Old World countries, which explains the intermediate effect.

[14] Sign and significance of the estimated coefficients persist even with importer-month and exporter-month fixed effects, as shown in column *i* of Appendix Table 5.

[15] Gravity variables were included in the estimations but omitted from Table 3 due to space considerations. Nevertheless, the magnitude and significance of the coefficients remained nearly the same (between -0.457 and -0.458 for distance and between 0.74 and 0.743 for common language). Results available upon request.

Table 3 Results of the PPML estimations considering the impact of the STR, the C&H, and the ECO on wine exports

Variables	Equation-1 (i)	Equation-2 (ii)	Equation-1 (iii)	Equation-2 (iv)	Equation-1 (v)	Equation-2 (vi)
$\log \text{C\&H}_{\text{exporter},t}$	0.012	0.010				
	(0.023)	(0.022)				
$\log \text{C\&H}_{\text{importer},t}$	− 0.123***	− 0.065**				
	(0.037)	(0.026)				
$\log \text{C\&H}_{\text{importer},t-1}$		− 0.066***				
		(0.020)				
$\log \text{C\&H}_{\text{importer},t-2}$		− 0.066**				
		(0.027)				
$\log \text{Str}_{\text{exporter},t}$			− 0.009	− 0.005		
			(0.024)	(0.023)		
$\log \text{Str}_{\text{importer},t}$			− 0.121***	− 0.072***		
			(0.029)	(0.021)		
$\log \text{Str}_{\text{importer},t-1}$				− 0.038*		
				(0.020)		
$\log \text{Str}_{\text{importer},t-2}$				− 0.072***		
				(0.019)		
$\log \text{Eco}_{\text{exporter},t}$					0.032	0.030
					(0.024)	(0.024)
$\log \text{Eco}_{\text{importer},t}$					− 0.017	− 0.006
					(0.011)	(0.009)
$\log \text{Eco}_{\text{importer},t-1}$						− 0.006
						(0.009)
$\log \text{Eco}_{\text{importer},t-2}$						− 0.008
						(0.012)
Constant	20.120***	20.301***	20.149***	20.286***	19.851***	19.868***
	(0.707)	(0.719)	(0.715)	(0.728)	(0.698)	(0.701)
Exporter controls	Yes	Yes	Yes	Yes	Yes	Yes
Importer controls	Yes	Yes	Yes	Yes	Yes	Yes
Time controls	Yes	Yes	Yes	Yes	Yes	Yes
N	206,097	197,539	206,097	197,539	206,097	197,539
pseudo-R^2	0.892	0.893	0.892	0.893	0.892	0.893
RESET	7.84***	4.55**	7.34***	9.86***	7.34***	2.94*

Robust standard errors in parentheses

STR = Stringency index; *C&H* = Containment and health index; *ECO* = Economic support index

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

hand, the C&H and the STR are composed, respectively, of 14 out of 16 and 9 out of 16 indicators in common with the OGR, so the similarity in results was expected. Naturally, the estimated coefficients for the C&H are a little closer because it only excludes the economic support indicators, which we have already noted are not statistically significant. The STR does not account for most health system policies, leading to a smaller and weakly significant estimated coefficient for the importer index with a one-month time lag.

Comparing the results of the present study with previous research is challenging due to the lack of studies estimating the impact of government measures to fight COVID-19 on the wine trade. However, a few studies have been published on aggregate trade and on different groups of products. Khorana et al. (2021) considered the total export values of 186 countries and found a significant negative impact only for the STR of exporting countries. Kejžar et al. (2022), focusing specifically on EU member states' exports, estimated that the STR in importing countries also acted as a deterrent to exports. Hansen et al. (2023) suggested that Chinese aggregate exports were negatively affected by the STR of importing countries. Arita et al. (2022) estimated an inverse relationship between the STR of both importing and exporting countries and the exports of non-agricultural products. However, for agricultural products, only the STR of importing countries had a significant impact, although the impact varied across different agricultural products.

The lack of clear convergence between our findings and some of those studies is expected and may be attributed to differences in the countries, time-span (none of them considers exports after 2020) and products analysed. In particular, studying aggregate products that encompass items with varying degrees of vulnerability to the pandemic's impact in terms of production is markedly different. Furthermore, while wine and several agricultural products may share some vulnerability to the closure of restaurants, they are products with different storability characteristics. It is worth noting that among the various groups of agricultural products considered by Arita et al. (2022), wine is not included, but distilled spirits are, and they were negatively affected solely by the STR of importing countries, as we find for wine.

Conclusion

The findings of this study reveal that government policy responses to COVID-19 had varying impacts on the wine trade depending on whether they were adopted by an importing or exporting country. Addressing RQ1, it is observed that only certain specific policies in a particular group of exporting countries (Old World) influenced wine exports. However, answering RQ2, there is evidence that government policy responses in importing countries, on the other hand, did affect the wine trade. This suggests that the closure of restaurants/bars and limitations on gatherings constrained demand for imported wines (at least in value terms). Additionally, it is interesting to observe that the intensity of these policies taken by importing countries had an effect lasting at least two months, while economic support policies had no significant impact on wine imports in the short term.

This study also shows that there are differences between the Old World and the New World exporting countries, thus addressing RQ3. It was observed that, in Old World countries, restrictions on internal movements harmed exports, which could be a consequence of their business model (Britta et al. 2022). In compensation, these countries suffered less from lower demand in importing countries since their wines are more frequently valued specifically for their geographical indications and are, consequently, less substitutable (Macedo et al. 2020a, 2020b).

The findings of this paper have managerial implications for the wine industry, drawing attention to the importance of developing contingency marketing plans, conducting sensitivity and risk analyses, and following management strategies for diversifying markets (Arriola et al. 2022). Moreover, as we observed differences between Old and New World countries, sectoral policies should be adjusted to the business model of each country or group of countries. For Old World countries, their business model with producers located farther away from distributors and consumers was revealed to be a weakness when government policies constrained the supply chain. Therefore, to face future exogenous shocks, getting closer to consumers is a challenge for wineries in these countries. However, Britta et al. (2022) suggest that the willingness to invest in direct-to-consumer sales and communication is significantly higher in New World countries, as well as Portugal, Germany, and Austria than it is in Italy, France, and Spain. For New World countries, the challenge is different, yet it is at least as demanding. One of their weaknesses on the international demand side during the pandemic period was the higher degree of substitutability of their wines. So, developing the reputation of geographical indications and brands may be crucial in coping with future exogenous shocks.

In conclusion, the novelty of this research adds value to the literature by using an extended gravity model to estimate the impact on trade provoked by government restrictive policies, but not without limitations. Specifically, our estimations do not include the gross domestic product due to lack of data at the monthly level, and varying levels of risk/uncertainty for the future of the wine industry are not taken into account either. Future research should take these limitations into account and assess the long-term impact on the wine trade of government policies in responding to COVID-19 (Wittwer and Anderson 2021), along with its relation to inflation, rising interest rates, adaptation to climate changes (namely in terms of ecological footprint control and new vineyard locations), and new trends in consumption (Macedo et al. 2020c). That said, a more data-driven approach (Larkin and McManus 2020) is a possible avenue to extend the knowledge base in this area.

Appendix

See Tables 4 and 5.

Table 4 Descriptive statistics. *Source*: Own computation

Variables	Observations	Mean	Median	Standard deviation	Minimum	Maximum
Exports	225,105	719,260	0	5,834,586	0	265,214,688
Contig	225,105	0.0	0.0		0	1
Dist	225,105	8329.6	7964.4	4670.4	59.6	19,747.4
Comlang	225,105	0.1	0.0		0	1
Colony	225,105	0.0	0.0		0	1
$OGR_{exporter}$	225,105	30.2	27.0	30.7	0	87.6
$OGR_{importer}$	206,097	24.1	0.0	27.5	0	88.8
$Str_{exporter}$	225,105	27.9	14.4	30.4	0	99.5
$Str_{importer}$	206,097	23.8	0.0	28.7	0	100
$C\&H_{exporter}$	225,105	30.4	29.4	30.7	0	85.8
$C\&H_{importer}$	206,097	25.0	0.0	28.3	0	89.0
$Eco_{exporter}$	225,105	29.2	0.0	36.7	0	100
$Eco_{importer}$	206,097	18.3	0.0	29.4	0	100
StayAtHome	225,105	0.5	0.0		0	3
InternalMove	225,105	0.4	0.0		0	2
OldNew	225,105	1.0	1.0		0	2

Table 5 Results of the PPML estimations considering exporter-month and importer-month controls or pair controls

Variables	Equation-1 (i)	Equation-1 (ii)	Equation-2 (iii)
log Dist	− 0.458***		
	(0.084)		
Comlang	0.758***		
	(0.175)		
Colony	0.297		
	(0.509)		
Contig	0.284		
	(0.298)		
log $OGR_{exporter,t}$		0.012	0.006
		(0.030)	(0.029)
log $OGR_{importer,t}$		− 0.119***	− 0.060**
		(0.040)	(0.027)
log $OGR_{importer,t-1}$			− 0.066***
			(0.022)
log $OGR_{importer,t-2}$			− 0.061**
			(0.027)
Constant	19.945***	16.922***	17.090***
	(0.710)	(0.095)	(0.138)
Exporter controls	No	No	No
Importer controls	No	No	No
Time controls	No	Yes	Yes
Exporter-time controls	Yes	No	No
Importer-time controls	Yes	No	No
Pair controls	No	Yes	Yes
N	212,422	133,035	126,563
pseudo-R^2	0.906	0.971	0.971

Robust standard errors in parentheses

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

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Author contributions

AM collected the data and contributed to the literature review, data analysis, interpretation of results, and writing of the manuscript. JR contributed to the identification of the research questions, data analysis, and interpretation of results. SG contributed to the conceptualization and methodology, interpretation and discussion of the results and revised the manuscript. All authors agreed to the final version of the manuscript.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests

The authors declare no conflict of interest.

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