Paper/Poster Title	Predicting quality across space: a Machine Learning model for the acknowledgement of Geographical Indications

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Abstract	200 words max

Geographical Indications, as Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI), offer a unique protection scheme to preserve high-quality agri-food productions and support rural development, and they have been recognised as a powerful tool to enhance sustainable development and ecological economic transaction at the territorial level. However,not all the areas with traditional agri-food products are acknowledge with a GI. Examining Italian wine sector and focusing on the through a geo-referenced database and by using a machine learning framework, we show that municipalities which obtain a GI within the following 10 years (2002-2011) can be predicted using a large set of (lagged) municipality-level data (1981-2001). We find that the Random Forest algorithm is the best model to make out-of-sample predictions of municipalities which obtain GIs. Among the features used, the wine growing tradition of municipalities and regions, local employment and education rates emerge as crucial in the prediction of GI certifications. This evidence can support policy makers and stakeholders to target rural development policies and investment allocation, and it offers strong policy implications for the future reforms of this quality scheme.

Keywords	Geographical Indications; Rural Development; Agri-Food Production; Machine Learning; Geo-Referenced Data
JEL Code	C53; 013; Q18

Introduction	100 – 250 words

Geographical Indications (GIs) are the main scheme of the European Union quality policy aiming at protecting the names of specific products to promote their uniqueness (characteristics, reputation and quality) essentially or exclusively resulting from the characteristics of their region of origin as well as traditional know-how. Although the main effect of GIs can be summarised as preserving the agri-food biodiversity of local high-quality production, GIs can exert several positive economic effects at both individual and collective level. Certainly, in practice, local stakeholders (e.g., institutions, farmers, administrative authorities) do not have all the information useful for concluding that a specific, maybe new, GI will be successfully for the region of origin. And, what is more, they do not know if that territory can ever be acknowledge with a GI at a certain point in time. What is certain is, in fact, that not all the traditional and quality agri-food productions existing in the world will become a GI. Examining the Italian wine sector and focusing on wines entitled with the highest level of GI (Protected Designation of Origin - PDO), this paper proposes a specific model to predict the territorial PDO acknowledgement, using a large set of lagged geo-referenced municipality-level

indicators and Machine Learning algorithms. The scope is test whether ex-ante spatial features contain enough information to predict the future acknowledgment of a GI.

Methodology   *100 – 250 words*

The model is developed on 1508 municipalities (999 municipalities who do not get PDO in 2002-2011 and 509 who get PDO in 2002-2011). To conduct the analysis we rely on a municipality-level geo-referenced database arranged by matching census data collected by the Italian National Institute of Statistics (ISTAT), remote sensing data, and data obtained directly by digitalizing product specifications. Our task is to correctly predict the municipalities who get PDO using predictors of three (past) time points: 2001, 1991, 1981. Four different models of Machine Learning have been analyzed: Least Absolute Shrinkage and Selection Operator (LASSO), the Random Forest (RF), • the Gradient Boosting Machines (GBM) and the Newral Network (NN).

Results   *100 – 250 words*

Our results suggest that it is possible to make out-of-sample predictions of municipalities that have obtained the PDO status for wine productions in the period 2002-2011, with socioeconomic, agri-food sector related, and territorial characteristics of municipalities referred to the past (1981-2001). The Random Forest algorithm is the best model to make out-of-sample predictions of municipalities with PDO with an accuracy of 84 per cent. Features' importance suggests that territorial factors play a significant role, and they are more important than socio-economic conditions to predict the inclusion of municipalities within a PDO wine area. Among the area-level indicators, the wine growing tradition of municipalities and regions, local employment and education rates emerge as crucial in prediction of the PDO acknowledgement. In particular, variables capturing the historical traditions, the specialisation and the presence of a local networks (local actors involved in winemaking) are among the top ten important features with all the different algorithms considered. This proved evidence of the importance of not only tangible capital (e.g., Utilised Agricultural Area - UAA), but also of intangible capital for the certification of PDO wines. The presence of local networks and linkages, some of which are formal and others informal, gives most Italian local production systems specialising in grapes and wine the characteristics of industrial districts, due to the local social, environmental and cultural (in a single word territorial) capital that is stratified there.

Discussion and Conclusion   *100 – 250 words*

The nexus between GI and territories is one of the pillar of the EU quality scheme, however so far literature has not attempted to provide econometric evidence of the conceptual ration

behind that scheme. For the first time in the literature, by using a predictive model, rather than ex-post evaluation techniques, this analysis has uncovered the role of territorial factors. From the policy perspective, this paper offers a valuable tool to predict areas that have the change of being acknowledge with PDO wines. This is important not only in order to implement rural development policies, but also to target investment (both private and public) allocation. At the same time, more linked to the GI quality scheme, this approach could also be relevant to investigate (i) if the GI scheme has been working in line with the regulative framework, (ii) which are the areas for which the request of an upgrade from PGI to PDO will be presumably accepted and (iii) which are the neighbouring municipalities that have more probability to be included within the production area if there will be a request of extending the demarcated area to satisfy the demand.