Insights at a Glance: Unravelling Spatial Trends with Bivariate Choropleth Mapping

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Abstract:

The rise of open data initiatives across the globe, advocating for free access to and use of data, has led to a large amount of data being freely available for reuse. This unrestricted availability of data has proved to be an important factor in achieving improved data-based decision-making, and statistical data is considered to play a major role in this process. The relevance of statistical data within European context is firmly emphasized with the 2019 Open Data Directive which states that openly available statistical data has the potential to significantly benefit society, economy and the environment – high-value data. However, the abundance of openly available statistical data can sometimes make it challenging to discern the significance of specific datasets, potentially causing certain data patterns to be overlooked and resulting in a restricted comprehension of crucial information. Given the spatial reference inherent in many statistical datasets, leveraging this spatial component presents a promising solution to address the aforementioned challenges. Traditional methods of exploring data with spatial components, such as visualization, offer a pathway to unlocking new insights and extracting value-added information.

Statistical data is a major driver of modern society as it plays a crucial role in research, policymaking and business planning. As largely numerical data covering different themes, such as population and economy, statistical data provide a quantitative basis for analysis which is often used for decision-making. This means that only the right contextualization of statistical data will allow to identify trends and develop and implement effective strategies and regulations. Although primarily numerical, it is the spatial component of statistical data that supports many of its application. This raises the following question: *How can we present this statistical data in a manner that not only depicts the patterns of phenomena but also facilitates informed decision-making?*

An effective approach to overcoming this challenge is through data visualisation. Data visualization is a powerful technique to present statistical data in a way that increases clarity, reveals patterns, and facilitates informed decision-making. Statistical data visualized on a map using spatial reference has the potential to provide insights that goes well beyond merely displaying data and can reveal spatial trends and relationship that are difficult to identify solely through examining raw statistical data. Therefore, visualization of statistical data on maps can make it easier for decision-makers to interpret information, formulate strategies, and allocate resources effectively. However, the effectiveness of statistical data visualization hinges on the appropriate selection of visualization methods, particularly map types. Different map types serve to various purposes, datasets, and user abilities, with each exerting a significant influence on user performance in map-related tasks.. This means that the choice of map type can have a significant impact on users' performance in map-related tasks. i.e. same information is visualised using different visualization methods which can affect the usability and efficiency of the map (Šašinka et al, 2021).

Statistical data can be visualised using a variety of mapping techniques, e.g. univariate choropleth maps. When using univariate choropleth maps, however, there is the limitation that only one thematic variable can be displayed at a time. This implies that when comparing two statistical variables simultaneously, univariate choropleth maps fall short, making it difficult to explore their relationships. Some studies (e.g. Carstensen, 1986) have shown, that different cartographic techniques, such as bivariate choropleth maps, have the ability to overcome this limitation. Their main advantage is that they support visualization of two variables on the same map, which is shown to be more effective than two side by side choropleth maps. Even though bivariate choropleth maps are visually more complex to understand, they are a powerful means of revealing information about related geographic phenomena and patterns between two variables (Calka, 2021).

Building upon the growing availability of open statistical data, and recognizing its role in modern policymaking, this paper seeks to: (a) explore the potential of bivariate choropleth maps in revelling spatial relationship and patterns between two statistical variables, (b) highlight the importance of spatial component of statistical data in the right contextualization of statistical data, (c) advocate for open data initiatives to promote data accessibility, transparency and accountability in decision-making processes.

To achieve these objectives, we have created two bivariate choropleth maps (Figure 1), that provide an insight into the regional differences and the dynamics of changes in the demand and supply of Information and Communication Technology (ICT) specialists in Europe for 2014 and 2022. Nowadays, digitally skilled citizens are the key to adapting to the new technologies that are already part of our daily lives. Therefore, it is more important than ever to identify the true level of digitally skilled professionals and their real needs in society. The visualization of this data on a bivariate choropleth map could help in this process, by identify countries facing shortages in ICT specialists or ICT-specific jobs.

By analysing these datasets, we have identified regional differences and trends, highlighting the need for tailored employment and education policies at EU level. Understanding regional differences is crucial for the development of targeted employment and education policies. In regions where ICT is lagging behind, efforts must be made to improve the education and training of ICT experts – to boost the development of the ICT industry. In regions with high demand for ICT experts, it is important to ensure adequate support for education and training so that the workforce meets the needs of the labour market.
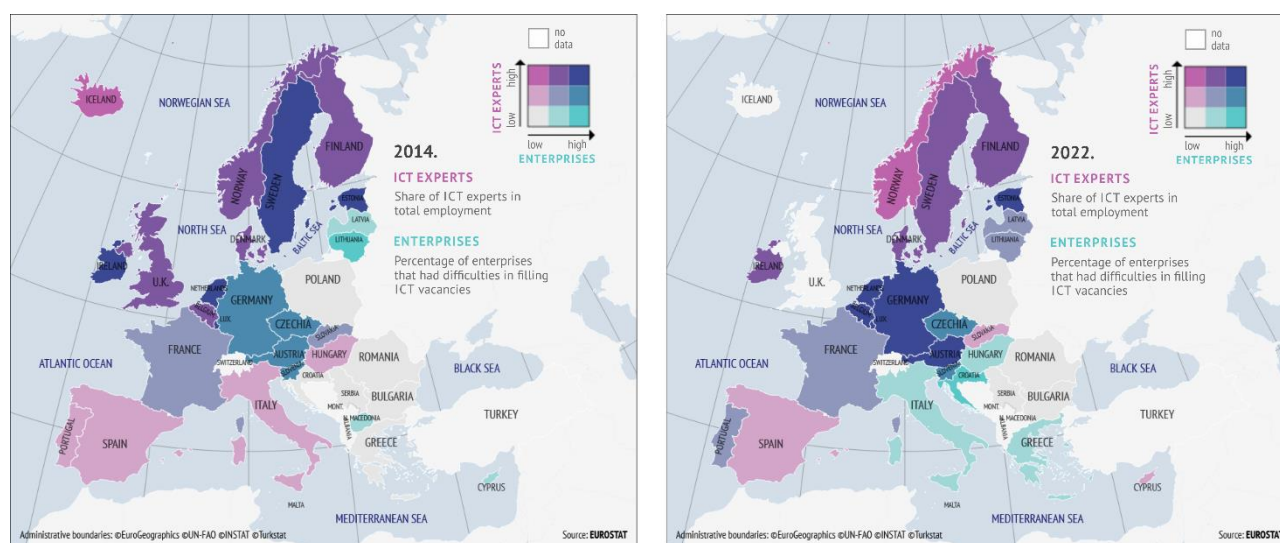

Figure 1. Bivariate choropleth maps with a comparative representation of ICT-qualified professionals (share of ICT experts in total employment) and enterprises that had difficulties in filling ICT vacancies (in percentages): (left) status in 2014 and (right) status in 2022

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