



# Defining and Measuring Tight and Loose Cultures Across NUTS-2 Regions: The Regional Index of Looseness

Vincenzo Alfano<sup>1</sup> · Salvatore Ercolano<sup>2</sup>

Received: 16 October 2025 / Accepted: 30 March 2026

© The Author(s) 2026

## Abstract

This study introduces the Regional Index of Looseness (RIL), a novel measure of cultural tightness-looseness computed at the NUTS-2 regional level for European countries. We distinguish between horizontal and vertical looseness, grounded respectively in interpersonal norm flexibility and attitudes toward supraordinate authority, and construct the index using dispersion in ordinal responses with data from the European Values Study. Methodologically, we employ an index of ordinal variation that avoids the limitations of the standard deviation when applied to Likert-type scales. We validate the RIL by comparing it with existing national-level tightness-looseness measures and by examining its association with other cultural constructs. Finally, we propose two exploratory applications (vaccination attitudes and compliance with non-pharmaceutical interventions during COVID-19) to illustrate how regional looseness correlates with public health behaviors. The results highlight substantial within-country heterogeneity and demonstrate the usefulness of regional cultural measures for understanding behavioral responses to collective risks.

**Keywords** Tightness · Looseness · Culture · Regional studies

**JEL Classification** Z13 · O57 · I18

Culture is neither natural nor artificial,  
neither genetically transmitted nor rationally designed.  
It is a tradition of learnt rules of conduct which have been 'invented'  
and whose functions the acting individuals usually do not understand.-  
F. A. Hayek, The Constitution of Liberty

---

✉ Vincenzo Alfano  
vincenzo.alfano@uniparthenope.it

<sup>1</sup> DiSEGIM, University of Napoli "Parthenope", Naples, Italy

<sup>2</sup> University of Basilicata, Potenza, Italy

## 1 Introduction

Cultural tightness and looseness refer to the strength of social norms and the degree of tolerance for deviant behavior within societies (Pelto 1968; Gelfand et al. 2006). Tighter cultures are characterized by widely shared norms and stringent enforcement mechanisms, whereas looser cultures exhibit greater normative heterogeneity and higher tolerance for deviation. This conceptual framework has been extensively applied in the social sciences to account for cross-country differences in coordination, compliance, and collective behavior (Gelfand 2011; Uz 2015).

A growing body of empirical evidence indicates that cultural tightness and looseness significantly influence societal responses to external shocks and policy interventions, particularly where individual behavior is central to collective outcomes. This dimension has gained prominence in the analysis of global risks (including pandemics, environmental crises, and large-scale institutional reforms) where compliance with public regulations and coordination among individuals constitute critical determinants of policy effectiveness.

Despite its theoretical and practical relevance, empirical research on tightness and looseness has relied almost exclusively on national-level indicators. This limitation is especially problematic in the European context, where considerable cultural, institutional, and socio-economic heterogeneity exists within countries. Consequently, national averages may obscure meaningful subnational variation in the strength and enforcement of social norms, thereby constraining both theoretical interpretation and policy applicability.

The primary objective of this article is to address this gap by constructing a regional-level measure of cultural tightness and looseness for European NUTS-2 regions: the Regional Index of Looseness (RIL). Rather than testing specific hypotheses, this study adopts a measurement-oriented approach. Its aim is to provide a systematic and theoretically grounded operationalization that enables subsequent research to formulate and test fine-grained hypotheses regarding the role of culture at the subnational level.

To illustrate the analytical utility of the RIL, we present two validation-oriented empirical applications focusing on vaccination attitudes and compliance with non-pharmaceutical interventions (NPI) during the COVID-19 pandemic. These applications are not intended as causal analyses but rather as demonstrations of how regional variation in cultural looseness, across both horizontal and vertical dimensions, can illuminate important patterns of compliance and coordination.

By introducing a regional and multidimensional measure of cultural looseness, this study contributes to the literature on culture and institutions by connecting the tightness-looseness framework to subnational heterogeneity, thereby enhancing its relevance for empirical research and policy analysis.

The remainder of this article is organized as follows. Section 2 provides the theoretical background and conceptual framework, defining cultural tightness and looseness and introducing the distinction between horizontal and vertical dimension. Section 3 details the construction of the Regional Index of Looseness (RIL), drawing on EVS data at the NUTS-2 level. Section 4 presents descriptive evidence on the RIL and validates it against existing measures and socio-economic indicators. Section 5 demonstrates the analytical utility of the RIL through two empirical applications related to public

health. Section 6 concludes the paper with a discussion of the main findings and their implications for public policy and territorial governance.

## 2 Background and Conceptual Framework

### 2.1 Conceptual Framework: Positioning Cultural Tightness-Looseness

“Tightness” is an attribute that can be used to describe societies or groups with strong social norms and strict expectations for behaviors, in which deviation from these norms is less tolerated. “Looseness”, on the other hand, is located at the opposite end of an ideal continuum, and is an attribute that characterizes societies or groups with more flexible norms, in which individuals have greater freedom to deviate from established rules. It is important to note that the main interest of this tightness-looseness framework is not the specific direction of social values on a given topic, but rather the heterogeneity of the values and behavior expressed by individuals. In other words, in this context social scientists are not interested in looking at the norm itself, but focus instead on how far it is shared within a group. In that sense, a group of people with far-right sympathies may be as tight as a group of people with “woke” tendencies: the norms to which the two groups adhere are extremely different, nonetheless in both cases within the group there is extreme adherence to these norms. As pointed out by Uz (2015: 319), “in a tight culture, people’s values, norms, and behavior are similar to each other. Thus, cultural tightness can be conceptualized as homogeneity in values, norms, and behaviors”.

Importantly, tightness-looseness captures a regulatory dimension of culture, focusing on the strength and enforcement of social norms rather than on their substantive content.

With all due differences, this distinction can be theoretically grounded in the literature on cultural individualism-collectivism. Such constructs, initially popularized by Hofstede (1980), distinguish cultures according to the degree to which personal goals and autonomy are prioritized over group cohesion and collective goals. While closely related, individualism-collectivism and tightness-looseness capture distinct dimensions of culture. More specifically, individualism emphasizes independence, self-reliance, and personal achievement. People in individualistic cultures are encouraged to pursue their own interests, prioritize their own goals, and express their unique identity. Collectivism focuses on interdependence, group harmony, and loyalty to groups such as family, community, or a whole nation. In collectivist cultures, individuals are expected to prioritize group goals over personal desires, conform to social norms, and maintain harmonious relationships.

Theoretical constructs like these have been extended through the conceptualization of horizontal and vertical individualism-collectivism (Triandis 1995; Triandis and Gelfand 1998), to reflect the ways in which status and equality are treated within these cultural frameworks. This distinction is aimed at placing individualism-collectivism on a larger spectrum, but one can identify the line of demarcation between horizontal and vertical dimensions in the relations based, respectively, on equality and on hierarchy.

As for tightness and looseness, individualism and collectivism have also been widely applied to various types of emergency and crisis, including, recently, the COVID-19 pandemic. The distinction between individualistic and collectivistic societies can help policymakers to understand how cultural values influence behaviors and compliance in response to NPIs such as wearing masks, social distancing, and strict lockdowns. The main findings of the literature suggest, on the one hand, that collective societies are often more willing to comply with such measures because individuals place a high value on protecting the group. On the other hand, individualistic societies show a lower compliance with government restrictions because individuals tend to prioritize personal choice over group benefit (Bazzi et al. 2021). According to Biddlestone et al. (2020), the transmission channel of this difference can be found in the endorsement of conspiracy theories among people characterized by more individualistic orientations. A similar result is also found in other research, which emphasizes that collective societies tend to be more compliant since they give more centrality to group safety and the welfare of the community (Chan et al. 2020; Lu et al. 2021a and b; Maaravi et al. 2021) or because they perceive risk to a greater extent (Huynh 2020). Despite these general results, a more recent contribution suggests that individuals' behaviors may have also evolved during the pandemic according to economic and technological factors; here, the individualist-collective dimension can explain "the transmission difference in the early pandemic stage but should be interpreted with caution when applied to other conditions" (Jiang et al. 2022). It is worth noting, however, that the difference between the horizontal and vertical dimensions of individualism-collectivism can enrich the interpretation of the main findings of the cited literature. Following this rationale, several studies investigate how these dimensions affect compliance with NPIs (Basabe and Ros 2021; Lu et al. 2021a, b b; Matsumoto et al. 2021; Realo et al. 2021; Vignoles et al. 2021). These findings suggest that when looking at collectivistic societies, the vertical dimension leads to greater compliance due to respect for authority, while the horizontal dimension of collectivism has social norms driving compliance, rather than government mandates. As regards individualistic societies, the horizontal dimension also shows moderate compliance, with individuals following public health measures because they are triggered by ideals of equality, though they tend to resist strict mandates that interfere with personal freedoms. On the other hand, the vertical dimension tends to be correlated with the lowest level of compliance, since people are more focused on individual freedom. A more recent study on vaccination attitudes, focused on China, shows that the horizontal dimension of collectivism tends to be more effective at pushing people towards vaccination, by means of a perception of risk due to concern for others, rather than submission to authority (Jin et al. 2024), a result in line with what found in Europe with reference to vaccine attitude (Alfano and Ercolano 2022a).

These references say much about how cultural values play a role in affecting individual behavior and compliance, and consequently the effectiveness of policy measures, especially when it comes to facing a global risk such as a pandemic. Both individualism-collectivism and tightness-looseness deal with social norms and group behavior, but while individualism-collectivism focuses on the self's relationship with the group, tightness-looseness focuses on how rigidly social norms are enforced. These concepts often overlap, as collectivist societies tend to be tighter, and individualistic

societies tend to be looser, though there are exceptions, and the two dimensions operate somewhat independently. In this rationale it is possible to suppose that cultural context and political structure also play a role in shaping the tightness or looseness of a culture. Moreover, from a policymaker's perspective a community's level of homogeneity-heterogeneity regarding certain topics, and how this takes different forms in relation to others and to power, can be helpful when it comes to implementing sound policy and improving the effectiveness of institutions. For this reason, the proposed distinction between horizontal and vertical tightness-looseness adds a layer of nuance to understanding how social norms operate within a society. It explains the complexity of cultural behaviors in terms of peer interactions (horizontal) versus hierarchical authority relationships (vertical), showing that societies can be tight or loose in different ways across these dimensions.

The cultural constructs of tightness and looseness naturally evoke the concept of social capital, yet the two frameworks capture distinct dimensions of social organization. While both relate to collective behavior and normative structures, what we measure through the tightness-looseness lens differs fundamentally from social capital in its analytical focus and empirical operationalization.

In the economic and sociological literature, social capital is commonly conceptualized as a multidimensional construct encompassing social networks, trust, and norms that facilitate collective action (Woolcock, 1998; Putnam, 2000). A well-established typology distinguishes between bonding social capital (strong ties within homogeneous groups), bridging social capital (weaker ties across heterogeneous groups), and linking social capital (vertical ties connecting individuals to institutions and authorities) (Gannon and Roberts 2020; Kyne and Aldrich 2020). At first glance, these dimensions may appear to partially overlap with the horizontal and vertical distinction advanced in this paper. Specifically, tight cultural contexts may be associated with dense bonding ties and stringent in-group norm enforcement, whereas looser contexts may rely more heavily on bridging ties and exhibit greater tolerance for normative heterogeneity.

Notwithstanding these apparent parallels, cultural tightness-looseness remains analytically distinct from social capital. Whereas social capital pertains to the structure, density, and availability of social networks and relational ties, tightness-looseness captures the strength, clarity, and enforcement of social norms, irrespective of whether such norms are embedded in dense or sparse network configurations. Accordingly, societies may exhibit high levels of social capital while remaining culturally loose, or conversely display strong norm enforcement despite relatively limited bridging or linking ties. The Regional Index of Looseness is therefore not proposed as an alternative measure of social capital, but rather as a complementary analytical construct that illuminates the normative and sanctioning environment within which social networks operate.

From a broader economic perspective, the tightness-looseness framework can also be linked to a large body of economic research that has emphasized the role of culture, social capital, and trust in shaping cooperation, institutional quality, and policy outcomes. This literature has shown how values and norms are transmitted across generations and space, contributing to persistent territorial differences in behavior and economic performance (Giavazzi et al. 2019). While these contributions primarily

focus on explaining why individuals are willing to cooperate or comply with collective rules, the tightness-looseness framework offers a complementary perspective by highlighting how the strength and enforcement of social norms affect the costs of compliance.

From this viewpoint, looser cultural contexts (characterized by greater heterogeneity of norms and higher tolerance for deviation) may face higher informational, enforcement, and political costs when implementing public policies, even in the presence of high levels of social capital or trust. This perspective is consistent with insights from regional and spatial economics, which stress that institutions, governance, and policy effectiveness are deeply shaped by local contexts and territorial heterogeneity, particularly in Europe (Rodríguez-Pose 2018), characterized by persistent structural inequalities and divergent development trajectories (Iammarino et al. 2019). Related evidence shows that such territorial heterogeneity is also reflected in patterns of political discontent and declining trust in supranational institutions, highlighting how local socio-economic contexts mediate compliance and legitimacy (Dijkstra et al. 2020). By providing a regional-level measure of cultural looseness, the RIL complements existing economic approaches and offers a tool to study how cultural context shapes the feasibility and effectiveness of policy design. More specifically, cultural tightness and looseness can be seen as one of the socio-institutional dimensions contributing to region-specific patterns of compliance and coordination.

From what has been summed up so far, it is evident that tightness-looseness is a much debated and widely used theoretical construct; nevertheless, to the best of our knowledge, there is a gap in the existent literature. The dimensions used to measure the level of tightness-looseness in a certain society usually consider two different sets of individuals' preferences. The first dimension takes into account individual values generally linked to cultural elements that may be more or less shared with other individuals belonging to the same community in a horizontal relational system – that is, among potentially similar individuals. The second dimension relates to values more closely linked to the political and institutional vision of society. In this dimension, individuals express preferences within a vertical relational system that seeks to define the relationships between citizens and the institutions that govern them. Based on these theoretical considerations, it is therefore possible to separate the tightness-looseness construct into two different components: horizontal tightness-looseness, referring to the degree of looseness towards one's peers, and vertical tightness-looseness, referring to the degree of looseness towards the supraordinate power.

Taken together, these considerations help situate cultural tightness and looseness within a broader interdisciplinary framework and clarify how this construct complements existing cultural approaches, thereby guiding the interpretation of the empirical literature discussed below. To further clarify the positioning of the RIL relative to existing cultural and socio-institutional frameworks, Table 1 provides a comparative overview highlighting conceptual overlaps, measurement differences, and the specific contribution of the regional horizontal and vertical looseness dimensions.

**Table 1** Conceptual and empirical positioning of the Regional Index of Looseness (RIL) relative to related cultural frameworks

Framework	Core concept	Key dimension(s)	Level of analysis	What is measured	Relation to RIL	Main limitation addressed by RIL
Bonding/Bridging/Linking Social Capital (Putnam 2000; Kyne and Aldrich 2020; Gannon and Roberts 2020)	Social networks and ties facilitating cooperation	Bonding (strong ties), Bridging (weak ties), Linking (vertical ties to institutions)	Individual/community/regional	Structure and availability of social ties and networks	Conceptually related but distinct: RIL focuses on norm strength and enforcement, not network density	Social capital captures <i>who is connected to whom</i> , but not <i>how strongly norms are enforced</i>
Behavioral–institutional framework (Huggins and Thompson 2019, 2025)	Socio-spatial culture shaping agency and development	Social cohesion, rule adherence, collective action, values	Regional (subnational)	Cultural values, personality traits, institutional orientations	Complementary: RIL captures a specific regulatory dimension of socio-spatial culture	Framework is multidimensional but does not isolate tightness–looseness as a distinct construct
Cultural persistence and transmission (Giavazzi et al. 2019)	Intergenerational and spatial transmission of values	Persistence vs change of norms	National/regional	Stability of cultural traits over time	RIL consistent with partial persistence but allows for heterogeneity across dimensions	Does not distinguish between types of norms (horizontal vs vertical enforcement)

Table 1 (continued)

Framework	Core concept	Key dimension(s)	Level of analysis	What is measured	Relation to RIL	Main limitation addressed by RIL
Tightness–Looseness (national indices) (Gelfand et al. 2006, 2021; Uz 2015)	Strength and enforcement of social norms	Single aggregate dimension	National	Perceived norm strength and sanctions	RIL extends this framework to the regional level and disaggregates dimensions	National averages mask within-country heterogeneity
RIL—Horizontal Looseness (this paper)	Norm enforcement among peers	Horizontal norm homogeneity	Regional (NUTS-2)	Tolerance for deviation in peer relations	New contribution	Captures informal coordination and peer-based compliance
RIL—Vertical Looseness (this paper)	Norm enforcement vis-à-vis authority	Vertical norm enforcement	Regional (NUTS-2)	Attitudes toward rules and institutions	New contribution	Captures authority-related compliance costs and institutional legitimacy

## 2.2 Origins and Empirical Evolution of the Tightness-Looseness Framework

Building on the conceptual framework outlined above, this section reviews the origins and empirical evolution of the tightness-looseness framework, focusing on how it has been operationalized and applied in empirical research.

Starting from the seminal contribution of Pelto (1968), and following the extensive work of Gelfand and other scholars (Chan et al 1996; Gelfand et al. 2006, 2017, 2020, 2021; Gelfand 2011; Harrington and Gelfand 2014; Aktas et al. 2016; Li et al. 2017; Geeraert et al. 2019; Gelfand 2019a, b; Stamkou et al. 2019; Jackson et al. 2020), who first pursued Pelto's definition and then looked into the spread of the concept, the degree of cultural tightness or looseness has more recently become an important topic in the social sciences, and has been investigated in detail by a number of researchers.

From a normative perspective, according to Gelfand et al. (2017), it is incorrect to suppose that either tight or loose cultures are superior to the other. According to these scholars, an important characteristic linked to tightness and looseness is their adaptive function. Following this rationale, we might argue that tight cultures excel in situations requiring order, coordination, and social stability, while loose cultures may be better suited for situations where innovation, creativity, and adaptability are required.

It is important to note that tightness and looseness are relatively stable dimensions over time; however, it should also be recognized that these dimensions can change over very long periods of time, especially in response to crucial historical events, leadership shifts, or external pressures. The concepts of tightness and looseness have been applied in various fields, including business management, education, and consumer behavior. The distinction helps organizations and policymakers to understand how cultural norms influence decision-making and behavior. From a policymaker's perspective, the associated literature provides empirical evidence of how cultural tightness and looseness are associated with different patterns of compliance and coordination. The global crisis caused by the COVID-19 pandemic has given this point renewed interest. At the empirical level, however, the relationship between tightness and compliance is not univocal. Indeed, as pointed out by Gelfand et al. (2021), "tightness-looseness theory suggests that strict rules, and the order and coordination that tightness confers, has helped groups to coordinate to survive under high threat throughout history". In other words, if we look at the COVID-19 case, the results of Gelfand et al.'s (2021) study on a cross-country sample suggest that tighter countries were more effective than looser nations in dealing with COVID-19. Nevertheless, this finding has been partially questioned by Jones et al. (2022), whose analysis of COVID-19 vaccination in the USA takes a different perspective. Their results, which are based on US states, show that tighter societies report lower vaccination rates. The theoretical mechanism proposed by the authors to explain this result is grounded in the idea that vaccination choices are exogenous to the level of tightness-looseness in a society, and hence the risk management decisions of members of tighter cultures will be influenced by a social norm. In more detail, according to the authors: i) individuals living in looser societies will make risk management decisions individually, and are less worried about

the decisions of the other members of that society; ii) individuals living in looser societies tend to base their decisions on influential leaders or experts, whereas individuals living in tight cultures tend to look to each other when taking decisions.

More recent contributions have started to highlight the limitations of purely national-level analyses, pointing to the relevance of subnational variation in cultural tightness and looseness. An important complementary perspective in regional studies is offered by the behavioral-institutional framework developed by Huggins and Thompson (2019) and Huggins et al. (2025), which conceptualises regional development as shaped by socio-spatial culture, personality traits, institutional value orientations, and forms of human agency. While Huggins and Thompson (2019) provide a theoretical foundation, Huggins et al. (2025) offer an empirical application using data specific to Great Britain.

Taken together, these contributions underscore the relevance of cultural tightness and looseness for understanding social coordination and compliance, but they also reveal important limitations in existing empirical approaches. In particular, the reliance on national-level indicators constrains the analysis of within-country cultural heterogeneity and limits the applicability of the framework to contexts where policy design and implementation occur at the subnational level. Addressing this gap requires moving beyond aggregate measures toward a regionally disaggregated operationalization.

Such an operationalization must satisfy two fundamental criteria. First, it should be theoretically grounded in the recognition that cultural regulation operates through dual mechanisms: peer-based social interactions and hierarchical relationships with authority. Second, it must be empirically consistent with the multidimensional nature of the construct, explicitly distinguishing between horizontal and vertical dimensions of looseness to capture heterogeneity in norm enforcement across social and institutional domains. The following section translates these theoretical considerations into a concrete measurement strategy, specifying the data sources, indicators, and methodological choices that underpin the construction of the Regional Index of Looseness (RIL).

### 3 Data and Methodology

To build the RIL, we utilized regional data at the NUTS-2 level, sourced from the European Values Study (EVS) in its 2008 and 2017 editions (more details on this further below). In contrast to previous research, we also endeavour to disentangle the horizontal dimension of looseness from its vertical dimension in our index. More particularly, we consider two dimensions of the index: i) horizontal looseness, reflecting individuals' opinions on values that are more closely related to what is acceptable at the peer level, and what actions and behaviors are (or are not) considered acceptable; ii) and vertical looseness, which instead consists of dimensions that focus on societal opinions about the acceptability of the government side of the multifaceted diamond of values, and especially on the relationship of citizens with their ruling class. Moreover, unlike previous contributions, we apply a different empirical approach in calculating the heterogeneity in the answer within each region, which is a more appropriate measure of variability than that which is usually adopted in previous literature.

Before going into further detail, it seems imperative to note, as already referenced, that the literature concerning cultural tightness and looseness does not seek to gauge the specific direction or opinion of citizens on cultural dimensions. It aims instead to measure the degree of homogeneity or heterogeneity within a society on specific topics. Gelfand et al. (2021) stress that the strength of and tolerance for deviations from norms is operationalized as variation in norms, values, and behavior. Following this literature, Uz (2015) highlights how the SD is the natural statistic of interest for the measurement of Cultural Tightness-Looseness (CTL).

Indeed, previous operationalisations of tightness-looseness typically rely on the standard deviation (SD) to measure intra-cultural dispersion (Uz 2015). However, SD implicitly assumes equal distances between response categories, which is inappropriate for ordinal variables such as Likert-type items (Blair and Lacy 2000). To avoid imposing cardinal assumptions, we adopt the  $1 - l^2$  index, a normalised measure of ordinal dispersion that evaluates how far an observed distribution lies from the situation of maximal concentration. This index is specifically designed for ordered categorical data and therefore provides a more coherent basis for constructing the RIL. A technical note detailing the index is provided in Appendix A.

Measures of dispersion in ordinal variables must consider the difference between the distribution in discussion, and a theoretical homogeneously distributed set of preferences, which also considers all possible modalities of the response variable. One way to measure this has been proposed by Blair and Lacy (2000), who introduce the  $l^2$  measure, a normalized index of concentration that has in its complement,  $1 - l^2$ , a measure of dispersion (essentially identical to what had already been proposed by Berry and Mielke 1992).  $l^2$  indicates the relative position of a given distribution along the continuum from the maximum to the minimum dispersion possible, for an ordinal variable with  $k$  categories, where 0 represents maximum dispersion, and 1 maximum concentration, i.e. when all the observations fall into a single category (Blair and Lacy 2000). In more formal terms, defining  $F_i$  as the cumulative relative frequency for the  $i^{\text{th}}$  cell of the variable of interest  $Y$ :

$$1 - l^2 = \frac{\sum_{i=1}^{k-1} F_i(1 - F_i)}{(k - 1)/4} \quad (1)$$

The reader is directed to Appendix A, and to Blair and Lacy (2000) for the technical details; nonetheless, it is useful to highlight that  $1 - l^2$  can be interpreted as the proportion of the maximum possible sum of cumulative binomial variances exhibited by the observed distribution. Hence,  $1 - l^2$  can be seen as a normed distance, expressing how far in an  $F$ -dimensional space the observed distribution is from the point of maximal dispersion.

To compute the RIL, we picked a total of eighteen variables from the EVS (2017 and 2008). Fourteen questions represent the horizontal dimension of tightness-looseness, i.e. how acceptable certain types of different behavior are considered. These fourteen questions ask respondents: "Please tell me for each of the following whether you think it can always be justified, never be justified, or something in between (1 never-10 always)."

The questions include the 10 items from the so-called Morally Debatable Behaviors Scale (MDBS) (Harding and Phillips 1986), along with a further four questions on dishonest or illegal behavior. These two sets of questions, both of which are related to cultural dimensions (Vauclair and Fischer 2011), are typically treated separately by previous researchers (Vauclair and Fischer 2011; Minkov et al. 2013); nonetheless, previous literature recognizes that both tolerance for personal-sexual deviations and tolerance for violations of legal rules are both related to cultural looseness and belong to the horizontal dimension (Vauclair and Fischer 2011). These studies also suggest that another relevant dimension of cultural looseness may be the willingness to live near dissimilar others (Uz 2015). However, this set of variables, unlike the previous ones, is likely to be context-dependent (e.g. attitudes toward certain ethnicities may be related to the actual presence of migrants in a region), and thus risks introducing bias into our analysis. For this reason, we prefer not to use variables about neighborhood, and choose to compute the horizontal dimension of RIL using the MDBS and dishonest-illegal behavior questions. Please also note that the fact that the number of variables used in the horizontal and in the vertical dimensions of the RIL are different is not a problem, given that we do not use SD like previous contributions (where the number of variables used could indeed be a problem), and instead use  $1 - I^2$ , a measure of dispersion taken from a theoretical situation of perfect homogeneity, which hence should not be affected by the number of variables included.

The specific subjects (all those included in both EVS 2017 and EVS 2008) whose justifiability respondents are asked to rate on a scale of 1–10 are as follows:

1. Claiming state benefits which you are not entitled to;
2. Cheating on tax if you have the chance;
3. Taking the drugs marijuana or hashish;
4. Someone accepting a bribe in the course of their duties;
5. Homosexuality;
6. Abortion;
7. Divorce;
8. Euthanasia;
9. Suicide;
10. Having casual sex;
11. Avoiding a fare on public transport;
12. Prostitution;
13. Artificial insemination or in-vitro fertilization;
14. The death penalty.

The other four questions, whose heterogeneity we use to operationalize the vertical dimension of the RIL, are also taken from the EVS (2017 and 2008). These are the only questions related to the vertical dimension, i.e. the way the individual looks at the ruling power, in the EVS. These questions ask the respondents: “I’m going to describe various types of political systems and ask what you think about each as a way of governing this country. For each one, would you say it is a very good, fairly good, fairly bad or very bad way of governing this country? (1 very good-4 very bad).” The four types of political systems are:

1. Having a strong leader who does not have to bother with parliament and elections;

2. Having experts, not government, make decisions according to what they think is best for the country;
3. Having the army rule the country;
4. Having a democratic political system.

The selection of the questions employed in the construction of the RIL follows a theoretically grounded procedure informed by seminal contributions on cultural tightness-looseness (Gelfand et al. 2011; Harrington and Gelfand 2014; Uz 2015) and on normative permissiveness (Vauclair and Fischer 2011). For the horizontal component, we include items that capture tolerance for behavioral deviation, diversity in personal choices, and acceptance of non-conforming conduct. For the vertical component, we retain items that reflect individuals' willingness to question, disregard, or challenge authority, thereby aligning with conceptualisations of looseness as reduced hierarchical norm enforcement. We explicitly exclude EVS items that measure moral or ideological prescriptions unrelated to normative flexibility.

For each of these variables, the  $1 - I^2$  index of dispersion is computed at the NUTS-2 regional level (respondents for which this information is unavailable are dropped from the data). Please note that  $1 - I^2$  is a normalized index (bounded between 0 and 1), and hence the different number of modalities for the two sets of variables does not represent a problem (something that, on the other hand, cannot be granted for SD, and thus another reason for choosing our operationalization). The mean value is computed for each of the two sets, obtaining respectively the horizontal and the vertical dimensions of the RIL. Then, computing the mean value of the horizontal and vertical RIL, we obtain a third operationalization, namely, the overall RIL value.

Figure 1 presents all included items clearly, grouped according to the dimension they represent, and thereby provides full transparency of the item selection. Table 2 lists the items used to construct the RIL and their allocation to the horizontal and vertical dimensions. This approach ensures conceptual coherence without altering the established structure of the EVS questionnaire.

## 4 The Regional Index of Looseness (RIL): Descriptive Evidence and Validation

Following the aforementioned procedure, we obtained the RIL in its horizontal, vertical, and overall measures. The dataset generated is publicly available at: <https://sites.google.com/unibas.it/regionalindex-looseness/>. Results are presented in Table 3, which for each of the three operationalizations of the RIL presents the value both for all the NUTS-2 level regions for which it was possible to compute it, and for all the countries for which data for our aims are available.

From these operationalizations we checked, as a way of validating the index with established literature, the correlation with previous indexes. We used those of Uz (2015) and Gelfand (2021) and computed a correlation matrix using data for all the countries present in both datasets. Our results, presented in Table 4, have to be weighted due to the fact that different sets of countries are included in the analysis, and hence

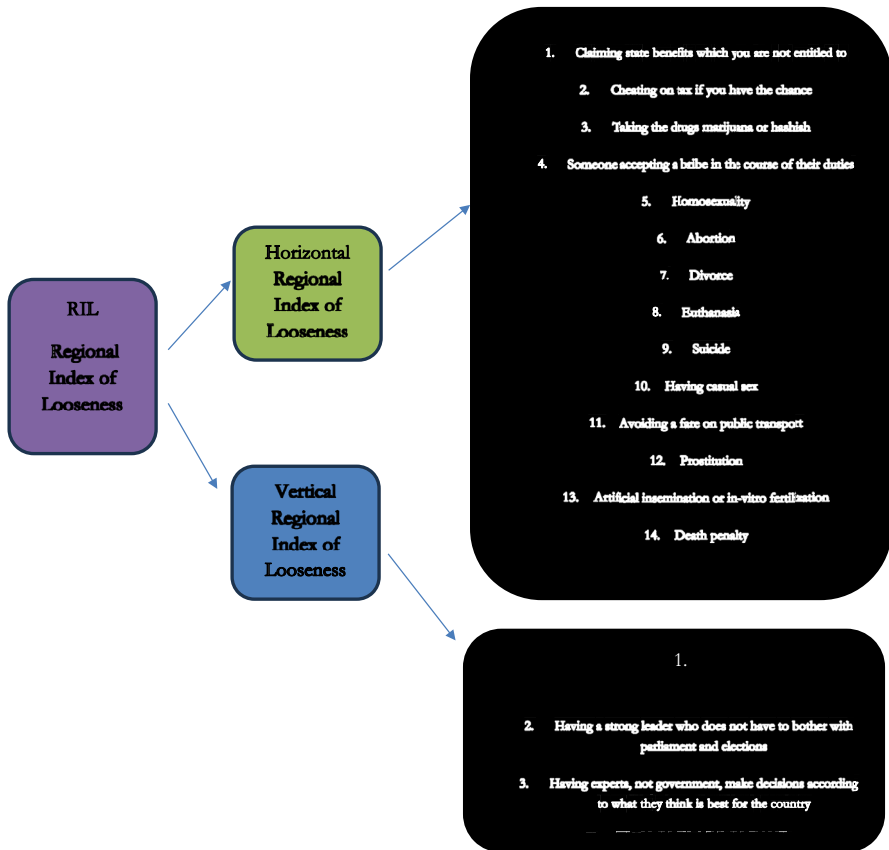


Fig. 1 Regional Index of Looseness, dimensions and questions used

the comparison is only between partial subsets. While certainly suboptimal, the comparison with a subset of countries is still informative, since it is a form of validation of the RIL with external data, hence increasing its external validity. Table 4 suggests an interesting degree of correlation, especially between the Cultural Tight-Loose Domain General index (CTL-DG) of Uz (2015) and our horizontal and overall measure of looseness, providing some external validity to the RIL.

Moreover, we computed the correlation between the RIL, a measure of social capital, and a measure of political polarization. In this way, we aimed to measure whether the RIL overlaps with these constructs, or whether, on the contrary, as we believe, our empirical construction measures a different dimension (namely the looseness of the region).

Social capital operationalization is derived from data from European Social Survey (ESS 2018). Given that social capital is a multidimensional construct (Gannon and Roberts 2020; Kyne and Aldrich 2020), following the approach of Denti et al. (2023), we construct an overall social capital index using principal component analysis (PCA). The index draws on personal relationship, social activity, interpersonal trust, perception

**Table 2** Items used to construct the regional index of looseness

EVS item	EVS question stem and scale	RIL dimension	What it operationalizes	Selection rationale and citations
Claiming state benefits which you are not entitled to	“Can it always be justified, never justified, or something in between?” (1 = never, 10 = always)	Horizontal	Tolerance for rule-violating deviance (peer-level norm permissiveness)	Tightness–looseness is operationalized as within-group dispersion in norms/values/behaviour, and these items capture tolerance for deviance independently of the substantive norm content (Gelfand et al. 2011; Uz 2015)
Cheating on tax if you have the chance	Same stem (1–10)	Horizontal	Tolerance for dishonest/illegal deviance	As above, captures permissiveness toward norm-violations rather than ideology, consistent with the “regulatory” interpretation of tightness–looseness (Gelfand et al. 2011; Harrington and Gelfand 2014)
Taking the drugs marijuana or hashish	Same stem (1–10)	Horizontal	Tolerance for nonconforming personal behaviour	Included as a canonical permissiveness item, suited to measuring heterogeneity in “acceptability boundaries” (Uz 2015; Vauclair and Fischer 2011)
Someone accepting a bribe in the course of their duties	Same stem (1–10)	Horizontal	Tolerance for corruption-related deviance	Links to “rule breaking” tolerance (normative permissiveness), central to tightness–looseness variation (Gelfand et al. 2011; Uz 2015)

Table 2 (continued)

EVS item	EVS question stem and scale	RIL dimension	What it operationalizes	Selection rationale and citations
Homosexuality	Same stem (1–10)	Horizontal	Tolerance for lifestyle deviation from traditional norms	Treated as permissiveness toward behavioural deviation; selection targets normative flexibility rather than a specific moral direction (Uz 2015; Vauclair and Fischer 2011)
Abortion	Same stem (1–10)	Horizontal	Tolerance for contested personal-choice behaviour	Included as “norm boundary” item to measure dispersion in acceptability judgments (Vauclair and Fischer 2011)
Divorce	Same stem (1–10)	Horizontal	Tolerance for family-norm deviation	As above (Vauclair and Fischer 2011)
Euthanasia	Same stem (1–10)	Horizontal	Tolerance for ethically contested deviance	As above, used to capture permissiveness dispersion rather than ideology (Uz 2015)
Suicide	Same stem (1–10)	Horizontal	Tolerance for taboo/nonconforming behaviour	Same logic (Uz 2015; Vauclair and Fischer 2011)
Having casual sex	Same stem (1–10)	Horizontal	Tolerance for sexual-norm deviation	Included as classic “moral permissiveness” indicator to capture heterogeneity in peer-level norm acceptance (Vauclair and Fischer 2011)

Table 2 (continued)

EVS item	EVS question stem and scale	RIL dimension	What it operationalizes	Selection rationale and citations
Avoiding a fare on public transport	Same stem (1–10)	Horizontal	Tolerance for minor rule breaking	Captures everyday norm violation, suitable for peer-level normative flexibility (Gelfand et al. 2011)
Prostitution	Same stem (1–10)	Horizontal	Tolerance for morally contested behaviour	Included as “acceptability boundary” item to measure dispersion, not direction (Vauclair and Fischer 2011)
Artificial insemination or in-vitro fertilization	Same stem (1–10)	Horizontal	Tolerance for nontraditional family/biotech choices	Included as permissiveness domain item; supports measuring heterogeneity in acceptance (Vauclair and Fischer 2011)
The death penalty	Same stem (1–10)	Horizontal	Tolerance for coercive sanctioning norm	Included because it loads on “acceptability of extreme sanctioning,” still a peer-level permissiveness judgment, and helps capture dispersion in normative boundaries (Uz 2015)

Table 2 (continued)

EVS item	EVS question stem and scale	RIL dimension	What it operationalizes	Selection rationale and citations
Having a strong leader who does not have to bother with parliament and elections	“Very good to very bad way of governing this country” (1 = very good, 4 = very bad)	Vertical	Attitudes toward concentrated authority (hierarchical norm enforcement)	Vertical dimension targets looseness/tightness in the citizen–authority relationship (hierarchical norm enforcement); tightness relates to stronger rule clarity/enforcement and deference to norms, including institutional ones (Gelfand et al. 2011; Harrington and Gelfand 2014)
Having experts, not government, make decisions according to what they think is best	Same stem (1–4)	Vertical	Preference for technocratic authority over democratic accountability	Captures tolerance for authority arrangements that bypass electoral contestation, informative for vertical norm enforcement attitudes (Gelfand et al. 2011)
Having the army rule the country	Same stem (1–4)	Vertical	Acceptance of coercive, non-democratic authority	Measures endorsement/rejection of authoritarian rule forms, relevant to vertical norm enforcement tolerance (Harrington and Gelfand 2014)
Having a democratic political system	Same stem (1–4)	Vertical	Attitudes toward democratic constraint on authority	Included to anchor the vertical dimension across authoritarian–democratic governance ideals, capturing dispersion in authority-related normative preferences (Gelfand et al. 2011)

**Table 3** Regional index of looseness

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Albania	AL01	0.3873099	0.3173964	0.4572234	0.4144911	0.3726951	0.4562871
Albania	AL02	0.4368015	0.410128	0.463475	0.4144911	0.3726951	0.4562871
Albania	AL03	0.4077532	0.3705771	0.4449292	0.4144911	0.3726951	0.4562871
Armenia	AM01	0.5572939	0.5128282	0.6017597	0.5331467	0.4618044	0.6044891
Armenia	AM02	0.5186185	0.4095269	0.62771	0.5331467	0.4618044	0.6044891
Armenia	AM03	0.4705652	0.3903402	0.5507902	0.5331467	0.4618044	0.6044891
Armenia	AM04	0.5090587	0.4594173	0.5587001	0.5331467	0.4618044	0.6044891
Austria	AT11	0.3758965	0.4235626	0.3282304	0.5350608	0.5965976	0.4735524
Austria	AT12	0.5713447	0.6005756	0.5421138	0.5350608	0.5965976	0.4735524
Austria	AT13	0.5076743	0.5992944	0.4160542	0.5350608	0.5965976	0.4735524
Austria	AT21	0.3404416	0.4355499	0.2453333	0.5350608	0.5965976	0.4735524
Austria	AT22	0.4773355	0.5627276	0.3919433	0.5350608	0.5965976	0.4735524
Austria	AT31	0.5804428	0.6040108	0.5568749	0.5350608	0.5965976	0.4735524
Austria	AT32	0.4759048	0.5836762	0.3681333	0.5350608	0.5965976	0.4735524
Austria	AT33	0.4981941	0.5325211	0.4638672	0.5350608	0.5965976	0.4735524
Austria	AT34	0.6390104	0.6829716	0.5950491	0.5350608	0.5965976	0.4735524
Azerbaijan	AZ-ABS	0.1638095	0.1353557	0.1922634	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-AGA	0.3011937	0.1726355	0.4297521	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-AGS	0.2738095	0.2142857	0.3333333	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-AGU	0.4047746	0.4063492	0.4032	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-AST	0.3361823	0.2384396	0.433925	0.4854063	0.4007525	0.5700601

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Azerbaijan	AZ-BA	0.48599	0.4346368	0.5373432	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-BAL	0.3962585	0.3877551	0.4047619	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-BAR	0.2753527	0.1803351	0.3703704	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-BEY	0.4543341	0.3240327	0.5846354	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-BIL	0.4798703	0.3461145	0.613626	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-GA	0.2707403	0.2120536	0.3294271	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-GAD	0.2304894	0.2202381	0.2407407	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-GOR	0.3263717	0.2475364	0.4052071	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-GYG	0.2528289	0.218874	0.2867838	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-HIAC	0.4830845	0.3789295	0.5872396	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-IMI	0.4800967	0.3169643	0.6432292	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-ISM	0.2642032	0.241473	0.2869333	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-KUR	0.1658568	0.0596048	0.2721089	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-LAN	0.2646825	0.2593651	0.27	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-MAS	0.3788583	0.2888801	0.4688365	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-MI	0.2792355	0.2107764	0.3476946	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-NEF	0.3104056	0.4726631	0.1481481	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-QAB	0.3466667	0.3733333	0.32	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-QAZ	0.2515383	0.1890026	0.3140741	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-QBA	0.4675125	0.2153018	0.7197232	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-QUS	0.4626741	0.3169224	0.6084259	0.4854063	0.4007525	0.5700601

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Azerbaijan	AZ-SAB	0.4053724	0.4083779	0.4023669	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-SAK	0.2984871	0.3209325	0.2760417	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-SAL	0.2896825	0.2460317	0.3333333	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-SAT	0.2624008	0.2123016	0.3125	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-SKR	0.3299603	0.2965873	0.3633333	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-SM	0.4764723	0.4598478	0.4930966	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-SMI	0.2681406	0.2403628	0.2959184	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-SMX	0.3947018	0.3993809	0.3900227	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-SR	0.3795757	0.2761581	0.4829932	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-TOV	0.2778605	0.2027116	0.3530093	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-XAC	0.4819508	0.5150102	0.4488913	0.4854063	0.4007525	0.5700601
Azerbaijan	AZ-ZAR	0.3220934	0.1979502	0.4462366	0.4854063	0.4007525	0.5700601
Belarus	BY01	0.5829954	0.557878	0.6081127	0.6051073	0.6121149	0.5980998
Belarus	BY02	0.5153115	0.5313734	0.4992495	0.6051073	0.6121149	0.5980998
Belarus	BY03	0.6103913	0.5950533	0.6257291	0.6051073	0.6121149	0.5980998
Belarus	BY04	0.5846246	0.5666159	0.6026334	0.6051073	0.6121149	0.5980998
Belarus	BY05	0.6215811	0.6675192	0.5756431	0.6051073	0.6121149	0.5980998
Belarus	BY06	0.5922335	0.598306	0.5861611	0.6051073	0.6121149	0.5980998
Belarus	BY07	0.5860394	0.6148138	0.557265	0.6051073	0.6121149	0.5980998
Belgium	BE10	0.51511	0.5104448	0.5197752	0.5518361	0.5663378	0.5373345
Belgium	BE21	0.5333155	0.5641321	0.502499	0.5518361	0.5663378	0.5373345

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Belgium	BE22	0.5382526	0.5640717	0.5124334	0.5518361	0.5663378	0.5373345
Belgium	BE23	0.5394553	0.5476861	0.5312244	0.5518361	0.5663378	0.5373345
Belgium	BE24	0.5125539	0.556424	0.4686838	0.5518361	0.5663378	0.5373345
Belgium	BE25	0.5534859	0.5559383	0.5510335	0.5518361	0.5663378	0.5373345
Belgium	BE31	0.4268392	0.4846309	0.3690476	0.5518361	0.5663378	0.5373345
Belgium	BE32	0.5969467	0.5965797	0.5973138	0.5518361	0.5663378	0.5373345
Belgium	BE33	0.5461819	0.5572727	0.535091	0.5518361	0.5663378	0.5373345
Belgium	BE34	0.5125863	0.5330212	0.4921514	0.5518361	0.5663378	0.5373345
Belgium	BE35	0.4881663	0.5376959	0.4386367	0.5518361	0.5663378	0.5373345
Bosnia and Herzegovina	BABIH	0.5790476	0.4821694	0.6759259	0.5848783	0.4824901	0.6872664
Bosnia and Herzegovina	BABRC	0.4341862	0.3638041	0.5045683	0.5848783	0.4824901	0.6872664
Bosnia and Herzegovina	BASRP	0.5778384	0.4862174	0.6694595	0.5848783	0.4824901	0.6872664
Bulgaria	BG31	0.4241717	0.3376094	0.5107341	0.5329245	0.4693697	0.5964794
Bulgaria	BG32	0.432552	0.3770702	0.4880337	0.5329245	0.4693697	0.5964794
Bulgaria	BG33	0.5557117	0.5574639	0.5539596	0.5329245	0.4693697	0.5964794
Bulgaria	BG34	0.4477655	0.3751664	0.5203646	0.5329245	0.4693697	0.5964794
Bulgaria	BG41	0.5530933	0.4990631	0.6071236	0.5329245	0.4693697	0.5964794
Bulgaria	BG42	0.4447022	0.3756047	0.5137997	0.5329245	0.4693697	0.5964794
Croatia	HR03	0.6229687	0.6491199	0.5968176	0.5849813	0.6042533	0.5657094
Croatia	HR04	0.5594442	0.5737162	0.5451721	0.5849813	0.6042533	0.5657094
Czechia	CZ01	0.5354369	0.6156583	0.4552154	0.5939818	0.6281019	0.5598617

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Czechia	CZ02	0.6290669	0.6644762	0.5936576	0.5939818	0.6281019	0.5598617
Czechia	CZ03	0.5122344	0.5324943	0.4919745	0.5939818	0.6281019	0.5598617
Czechia	CZ04	0.6399895	0.656845	0.623134	0.5939818	0.6281019	0.5598617
Czechia	CZ05	0.5244437	0.5427841	0.5061033	0.5939818	0.6281019	0.5598617
Czechia	CZ06	0.5662535	0.6203137	0.5121933	0.5939818	0.6281019	0.5598617
Czechia	CZ07	0.594835	0.6187189	0.5709511	0.5939818	0.6281019	0.5598617
Czechia	CZ08	0.6174585	0.6425337	0.5923832	0.5939818	0.6281019	0.5598617
Denmark	DK01	0.4247369	0.4665114	0.3829625	0.4530541	0.4792873	0.426821
Denmark	DK02	0.4518133	0.4684491	0.4351776	0.4530541	0.4792873	0.426821
Denmark	DK03	0.456978	0.4793488	0.4346071	0.4530541	0.4792873	0.426821
Denmark	DK04	0.4602797	0.479704	0.4408555	0.4530541	0.4792873	0.426821
Denmark	DK05	0.4696501	0.4808258	0.4584744	0.4530541	0.4792873	0.426821
Estonia	EE00	0.5094845	0.5444282	0.4745408	0.5094845	0.5444282	0.4745408
Finland	FI19	0.4977269	0.5248809	0.4705729	0.4986099	0.5325223	0.4646975
Finland	FI1B	0.4643837	0.5109563	0.4178111	0.4986099	0.5325223	0.4646975
Finland	FI1C	0.4918989	0.5131299	0.4706679	0.4986099	0.5325223	0.4646975
Finland	FI1D	0.5201389	0.5490072	0.4912705	0.4986099	0.5325223	0.4646975
France	FR10	0.5960978	0.6327068	0.559489	0.5873366	0.6265431	0.5481301
France	FRB0	0.6088057	0.6313199	0.5862914	0.5873366	0.6265431	0.5481301
France	FRC1	0.5950257	0.6090479	0.5810034	0.5873366	0.6265431	0.5481301
France	FRC2	0.5645254	0.6212021	0.5078486	0.5873366	0.6265431	0.5481301

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
France	FRD1	0.5245342	0.5699668	0.4791016	0.5873366	0.6265431	0.5481301
France	FRD2	0.4591303	0.5156751	0.4025854	0.5873366	0.6265431	0.5481301
France	FRE1	0.6113501	0.6283761	0.5943241	0.5873366	0.6265431	0.5481301
France	FRE2	0.5636359	0.6337302	0.4935417	0.5873366	0.6265431	0.5481301
France	FRF1	0.5893555	0.5709636	0.6077474	0.5873366	0.6265431	0.5481301
France	FRF2	0.483932	0.4688091	0.4990548	0.5873366	0.6265431	0.5481301
France	FRF3	0.5596312	0.5578679	0.5613944	0.5873366	0.6265431	0.5481301
France	FRG0	0.5609007	0.622978	0.4988235	0.5873366	0.6265431	0.5481301
France	FRH0	0.5378681	0.5901658	0.4855704	0.5873366	0.6265431	0.5481301
France	FR11	0.5375057	0.5641643	0.5108471	0.5873366	0.6265431	0.5481301
France	FR12	0.4804068	0.5545635	0.40625	0.5873366	0.6265431	0.5481301
France	FR13	0.5508157	0.5831129	0.5185185	0.5873366	0.6265431	0.5481301
France	FRJ1	0.5864577	0.6270741	0.5458412	0.5873366	0.6265431	0.5481301
France	FRJ2	0.5246711	0.6068683	0.442474	0.5873366	0.6265431	0.5481301
France	FRK1	0.6032242	0.653552	0.5528963	0.5873366	0.6265431	0.5481301
France	FRK2	0.5992796	0.6334747	0.5650846	0.5873366	0.6265431	0.5481301
France	FRL0	0.5753247	0.6508221	0.4998272	0.5873366	0.6265431	0.5481301
Georgia	GE01	0.4348689	0.3571914	0.5125464	0.4525864	0.365786	0.5393867
Georgia	GE02	0.4477031	0.3434111	0.5519951	0.4525864	0.365786	0.5393867
Georgia	GE03	0.4538356	0.3872315	0.5204397	0.4525864	0.365786	0.5393867
Germany	DE11	0.53338	0.6353875	0.4313726	0.5176274	0.5690723	0.4661826

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Germany	DE12	0.3602822	0.4746384	0.2459259	0.5176274	0.5690723	0.4661826
Germany	DE13	0.4456845	0.5293899	0.3619792	0.5176274	0.5690723	0.4661826
Germany	DE14	0.5139922	0.6437001	0.3842843	0.5176274	0.5690723	0.4661826
Germany	DE21	0.5074639	0.5187085	0.4962193	0.5176274	0.5690723	0.4661826
Germany	DE22	0.3775228	0.3007519	0.4542936	0.5176274	0.5690723	0.4661826
Germany	DE23	0.3796974	0.3000198	0.459375	0.5176274	0.5690723	0.4661826
Germany	DE24	0.2361111	0.2638889	0.2083333	0.5176274	0.5690723	0.4661826
Germany	DE25	0.4091005	0.3707936	0.4474074	0.5176274	0.5690723	0.4661826
Germany	DE26	0.1631746	0.1930159	0.1333333	0.5176274	0.5690723	0.4661826
Germany	DE27	0.4492885	0.468564	0.430013	0.5176274	0.5690723	0.4661826
Germany	DE30	0.6114556	0.6138255	0.6090857	0.5176274	0.5690723	0.4661826
Germany	DE41	0.5143546	0.508301	0.5204082	0.5176274	0.5690723	0.4661826
Germany	DE42	0.4462588	0.5037732	0.3887445	0.5176274	0.5690723	0.4661826
Germany	DE50	0.5157628	0.5176367	0.5138889	0.5176274	0.5690723	0.4661826
Germany	DE60	0.5344246	0.5580159	0.5108333	0.5176274	0.5690723	0.4661826
Germany	DE71	0.4627072	0.5450441	0.3803704	0.5176274	0.5690723	0.4661826
Germany	DE72	0.3752834	0.4376417	0.3129252	0.5176274	0.5690723	0.4661826
Germany	DE73	0.3253478	0.3996668	0.2510288	0.5176274	0.5690723	0.4661826
Germany	DE80	0.4960291	0.5402722	0.4517861	0.5176274	0.5690723	0.4661826
Germany	DE91	0.4391121	0.4401455	0.4380787	0.5176274	0.5690723	0.4661826
Germany	DE92	0.3951389	0.4344444	0.3558333	0.5176274	0.5690723	0.4661826

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Germany	DE93	0.379327	0.484254	0.2744	0.5176274	0.5690723	0.4661826
Germany	DE94	0.4747328	0.6059281	0.3435374	0.5176274	0.5690723	0.4661826
Germany	DEA1	0.4026397	0.4573442	0.3479351	0.5176274	0.5690723	0.4661826
Germany	DEA2	0.4845458	0.5547317	0.4143599	0.5176274	0.5690723	0.4661826
Germany	DEA3	0.4448684	0.5254694	0.3642674	0.5176274	0.5690723	0.4661826
Germany	DEA4	0.4161944	0.4992201	0.3331687	0.5176274	0.5690723	0.4661826
Germany	DEA5	0.4835952	0.5086033	0.4585871	0.5176274	0.5690723	0.4661826
Germany	DEB1	0.4207589	0.4346892	0.4068287	0.5176274	0.5690723	0.4661826
Germany	DEB3	0.3751215	0.4237123	0.3265306	0.5176274	0.5690723	0.4661826
Germany	DEC0	0.4859886	0.4658044	0.5061728	0.5176274	0.5690723	0.4661826
Germany	DED2	0.4327654	0.4602539	0.405277	0.5176274	0.5690723	0.4661826
Germany	DED4	0.320359	0.3134718	0.3272462	0.5176274	0.5690723	0.4661826
Germany	DED5	0.3791316	0.3635524	0.3947107	0.5176274	0.5690723	0.4661826
Germany	DEE0	0.4462568	0.4908839	0.4016296	0.5176274	0.5690723	0.4661826
Germany	DEF0	0.4848169	0.5410971	0.4285367	0.5176274	0.5690723	0.4661826
Germany	DEG0	0.4616961	0.4457995	0.4775927	0.5176274	0.5690723	0.4661826
Great Britain	UKC1	0.607074	0.6024581	0.6116898	0.5679101	0.5758734	0.5599468
Great Britain	UKC2	0.6217422	0.57048	0.6730044	0.5679101	0.5758734	0.5599468
Great Britain	UKD1	0.4469841	0.4139683	0.48	0.5679101	0.5758734	0.5599468
Great Britain	UKD3	0.5507307	0.5747124	0.526749	0.5679101	0.5758734	0.5599468
Great Britain	UKD4	0.5317108	0.5264394	0.5369822	0.5679101	0.5758734	0.5599468

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Great Britain	UKD6	0.5409083	0.5303351	0.5514815	0.5679101	0.5758734	0.5599468
Great Britain	UKD7	0.5618319	0.56414	0.5595238	0.5679101	0.5758734	0.5599468
Great Britain	UKE1	0.47875	0.4716667	0.4858333	0.5679101	0.5758734	0.5599468
Great Britain	UKE2	0.553302	0.5448756	0.5617284	0.5679101	0.5758734	0.5599468
Great Britain	UKE3	0.5849931	0.566451	0.6035354	0.5679101	0.5758734	0.5599468
Great Britain	UKE4	0.5728329	0.5743353	0.5713306	0.5679101	0.5758734	0.5599468
Great Britain	UKF1	0.552958	0.5759627	0.5299532	0.5679101	0.5758734	0.5599468
Great Britain	UKF2	0.5837188	0.5548251	0.6126126	0.5679101	0.5758734	0.5599468
Great Britain	UKF3	0.6439831	0.5936179	0.6943483	0.5679101	0.5758734	0.5599468
Great Britain	UKG1	0.5199233	0.5501771	0.4896694	0.5679101	0.5758734	0.5599468
Great Britain	UKG2	0.5214267	0.5826869	0.4601665	0.5679101	0.5758734	0.5599468
Great Britain	UKG3	0.5718303	0.5465532	0.5971074	0.5679101	0.5758734	0.5599468
Great Britain	UKH1	0.5734419	0.5728674	0.5740163	0.5679101	0.5758734	0.5599468
Great Britain	UKH2	0.4977371	0.4706808	0.5247934	0.5679101	0.5758734	0.5599468
Great Britain	UKH3	0.5200106	0.5259733	0.5140479	0.5679101	0.5758734	0.5599468
Great Britain	UKI3	0.4975662	0.5595767	0.4355555	0.5679101	0.5758734	0.5599468
Great Britain	UKI4	0.6476884	0.6661711	0.6292057	0.5679101	0.5758734	0.5599468
Great Britain	UKI5	0.4733206	0.5381079	0.4085333	0.5679101	0.5758734	0.5599468
Great Britain	UKI6	0.4187302	0.5174603	0.32	0.5679101	0.5758734	0.5599468
Great Britain	UKI7	0.5543056	0.5775926	0.5310185	0.5679101	0.5758734	0.5599468
Great Britain	UKJ1	0.5346101	0.5316774	0.5375428	0.5679101	0.5758734	0.5599468

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Great Britain	UKJ2	0.50227	0.5469301	0.45761	0.5679101	0.5758734	0.5599468
Great Britain	UKJ3	0.5517293	0.5614572	0.5420015	0.5679101	0.5758734	0.5599468
Great Britain	UKJ4	0.5403057	0.5341114	0.5465001	0.5679101	0.5758734	0.5599468
Great Britain	UKK1	0.5080733	0.5212251	0.4949215	0.5679101	0.5758734	0.5599468
Great Britain	UKK2	0.4829295	0.4974171	0.4684418	0.5679101	0.5758734	0.5599468
Great Britain	UKK4	0.5007104	0.543799	0.4576218	0.5679101	0.5758734	0.5599468
Great Britain	UKL1	0.5532351	0.554478	0.5519922	0.5679101	0.5758734	0.5599468
Great Britain	UKL2	0.6459852	0.6036201	0.6883503	0.5679101	0.5758734	0.5599468
Great Britain	UKM5	0.4315109	0.4514991	0.4115226	0.5679101	0.5758734	0.5599468
Great Britain	UKM6	0.3844797	0.324515	0.4444444	0.5679101	0.5758734	0.5599468
Great Britain	UKM7	0.4575053	0.5249986	0.3900119	0.5679101	0.5758734	0.5599468
Great Britain	UKM8	0.4760183	0.5064443	0.4455923	0.5679101	0.5758734	0.5599468
Great Britain	UKM9	0.5731324	0.5169942	0.6292706	0.5679101	0.5758734	0.5599468
Greece	GR11	0.3455384	0.4858856	0.2051911	0.4791086	0.5620371	0.3961801
Greece	GR12	0.5084831	0.6187761	0.3981899	0.4791086	0.5620371	0.3961801
Greece	GR13	0.4071461	0.5262264	0.2880659	0.4791086	0.5620371	0.3961801
Greece	GR14	0.4630732	0.6164756	0.3096708	0.4791086	0.5620371	0.3961801
Greece	GR21	0.5622008	0.5006067	0.6237948	0.4791086	0.5620371	0.3961801
Greece	GR22	0.5119634	0.5372405	0.4866864	0.4791086	0.5620371	0.3961801
Greece	GR23	0.3213921	0.3918377	0.2509465	0.4791086	0.5620371	0.3961801
Greece	GR24	0.4857206	0.4765079	0.4949333	0.4791086	0.5620371	0.3961801

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Greece	GR25	0.4565136	0.4504494	0.4625778	0.4791086	0.5620371	0.3961801
Greece	GR30	0.4762424	0.5700871	0.3823977	0.4791086	0.5620371	0.3961801
Greece	GR41	0.3665675	0.3639683	0.3691667	0.4791086	0.5620371	0.3961801
Greece	GR42	0.2632977	0.2675478	0.2590476	0.4791086	0.5620371	0.3961801
Greece	GR43	0.3477637	0.35811	0.3374174	0.4791086	0.5620371	0.3961801
Hungary	HU11	0.5308231	0.6028393	0.4588068	0.5466495	0.5801877	0.5131111
Hungary	HU12	0.5512521	0.6084948	0.4940095	0.5466495	0.5801877	0.5131111
Hungary	HU21	0.5664966	0.6028207	0.5301724	0.5466495	0.5801877	0.5131111
Hungary	HU22	0.5144334	0.5660428	0.4628241	0.5466495	0.5801877	0.5131111
Hungary	HU23	0.5020754	0.528985	0.4751658	0.5466495	0.5801877	0.5131111
Hungary	HU31	0.5362808	0.5112832	0.5612785	0.5466495	0.5801877	0.5131111
Hungary	HU32	0.5229737	0.5376031	0.5083441	0.5466495	0.5801877	0.5131111
Hungary	HU33	0.5286285	0.5230846	0.5341724	0.5466495	0.5801877	0.5131111
Iceland	IS00	0.4171158	0.466067	0.3681646	0.4171158	0.466067	0.3681646
Italy	ITC1	0.5365704	0.5597528	0.513388	0.5539993	0.5734791	0.5345196
Italy	ITC3	0.5244774	0.5557995	0.4931553	0.5539993	0.5734791	0.5345196
Italy	ITC4	0.5139754	0.5526384	0.4753125	0.5539993	0.5734791	0.5345196
Italy	ITF1	0.4740018	0.4456951	0.5023084	0.5539993	0.5734791	0.5345196
Italy	ITF2	0.2857143	0.2751323	0.2962963	0.5539993	0.5734791	0.5345196
Italy	ITF3	0.6034082	0.6196771	0.5871392	0.5539993	0.5734791	0.5345196
Italy	ITF4	0.5592728	0.5984093	0.5201364	0.5539993	0.5734791	0.5345196

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Italy	ITF5	0.4757511	0.5178228	0.4336793	0.5539993	0.5734791	0.5345196
Italy	ITF6	0.5870962	0.5257549	0.6484375	0.5539993	0.5734791	0.5345196
Italy	ITG1	0.5486363	0.5362346	0.561038	0.5539993	0.5734791	0.5345196
Italy	ITG2	0.5277929	0.6288199	0.4267659	0.5539993	0.5734791	0.5345196
Italy	ITH1	0.4351312	0.4450923	0.4251701	0.5539993	0.5734791	0.5345196
Italy	ITH2	0.5328171	0.463558	0.6020761	0.5539993	0.5734791	0.5345196
Italy	ITH3	0.512926	0.5353853	0.4904668	0.5539993	0.5734791	0.5345196
Italy	ITH4	0.4668933	0.5108553	0.4229313	0.5539993	0.5734791	0.5345196
Italy	ITH5	0.5144426	0.5384676	0.4904175	0.5539993	0.5734791	0.5345196
Italy	ITI1	0.5281791	0.5860332	0.470325	0.5539993	0.5734791	0.5345196
Italy	ITI2	0.4248819	0.4492818	0.4004821	0.5539993	0.5734791	0.5345196
Italy	ITI3	0.4460716	0.4599055	0.4322376	0.5539993	0.5734791	0.5345196
Italy	ITI4	0.4701869	0.4821415	0.4582323	0.5539993	0.5734791	0.5345196
Latvia	LV00	0.5464118	0.5436418	0.5491817	0.5464118	0.5436418	0.5491817
Lithuania	LT01	0.540403	0.554818	0.525988	0.570282	0.5388433	0.6017206
Lithuania	LT02	0.5644337	0.5136138	0.6152535	0.570282	0.5388433	0.6017206
Moldova	MD00	0.5046793	0.4143047	0.5950539	0.5046793	0.4143047	0.5950539
Montenegro	ME00	0.5552129	0.474165	0.6362607	0.5552129	0.474165	0.6362607
Netherlands	NL11	0.5029744	0.524886	0.4810629	0.5063049	0.5377902	0.4748196
Netherlands	NL12	0.5080357	0.5371951	0.4788762	0.5063049	0.5377902	0.4748196
Netherlands	NL13	0.4812875	0.4991571	0.463418	0.5063049	0.5377902	0.4748196

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Netherlands	NL21	0.5312446	0.5545125	0.5079768	0.5063049	0.5377902	0.4748196
Netherlands	NL22	0.5168474	0.5406479	0.4930469	0.5063049	0.5377902	0.4748196
Netherlands	NL23	0.487591	0.5214974	0.4536846	0.5063049	0.5377902	0.4748196
Netherlands	NL31	0.4775335	0.5201333	0.4349337	0.5063049	0.5377902	0.4748196
Netherlands	NL32	0.4749247	0.501366	0.4484833	0.5063049	0.5377902	0.4748196
Netherlands	NL33	0.5036026	0.5388937	0.4683114	0.5063049	0.5377902	0.4748196
Netherlands	NL34	0.5222211	0.551625	0.4928171	0.5063049	0.5377902	0.4748196
Netherlands	NL41	0.5027997	0.5367764	0.4688232	0.5063049	0.5377902	0.4748196
Netherlands	NL42	0.4950606	0.5090146	0.4811065	0.5063049	0.5377902	0.4748196
North Macedonia	MK00	0.563536	0.5276005	0.5994716	0.563536	0.5276005	0.5994716
Norway	NO01	0.4362884	0.5068001	0.3657767	0.451974	0.5073352	0.3966129
Norway	NO02	0.4383436	0.4724304	0.4042567	0.451974	0.5073352	0.3966129
Norway	NO03	0.4789969	0.5347853	0.4232085	0.451974	0.5073352	0.3966129
Norway	NO04	0.4408475	0.5008402	0.3808548	0.451974	0.5073352	0.3966129
Norway	NO05	0.4360473	0.4823304	0.3897641	0.451974	0.5073352	0.3966129
Norway	NO06	0.4526516	0.4711876	0.4341157	0.451974	0.5073352	0.3966129
Norway	NO07	0.4295207	0.4772388	0.3818027	0.451974	0.5073352	0.3966129
Poland	PL21	0.5094403	0.5063618	0.5125189	0.550667	0.5687831	0.5325509
Poland	PL22	0.5833058	0.6088698	0.577418	0.550667	0.5687831	0.5325509
Poland	PL41	0.5395579	0.5160527	0.563063	0.550667	0.5687831	0.5325509
Poland	PL42	0.5743331	0.5924324	0.5562337	0.550667	0.5687831	0.5325509

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Poland	PL43	0.5689981	0.6206679	0.5173283	0.550667	0.5687831	0.5325509
Poland	PL51	0.5218194	0.5819309	0.4617078	0.550667	0.5687831	0.5325509
Poland	PL52	0.5697728	0.6013749	0.5381708	0.550667	0.5687831	0.5325509
Poland	PL61	0.5651845	0.5918618	0.5385072	0.550667	0.5687831	0.5325509
Poland	PL62	0.4322773	0.4513315	0.4132231	0.550667	0.5687831	0.5325509
Poland	PL63	0.5411201	0.5528126	0.5294276	0.550667	0.5687831	0.5325509
Poland	PL71	0.536153	0.5411419	0.5311639	0.550667	0.5687831	0.5325509
Poland	PL72	0.4909207	0.4655746	0.5162667	0.550667	0.5687831	0.5325509
Poland	PL81	0.4770021	0.4657305	0.4882737	0.550667	0.5687831	0.5325509
Poland	PL82	0.4938226	0.5082816	0.4793636	0.550667	0.5687831	0.5325509
Poland	PL84	0.4798474	0.4697927	0.4899022	0.550667	0.5687831	0.5325509
Poland	PL91	0.6044919	0.6609728	0.5480109	0.550667	0.5687831	0.5325509
Poland	PL92	0.5040096	0.5142949	0.4937243	0.550667	0.5687831	0.5325509
Portugal	PT11	0.5276263	0.5064196	0.5488331	0.5052219	0.5190144	0.4914294
Portugal	PT15	0.2769806	0.3387188	0.2152423	0.5052219	0.5190144	0.4914294
Portugal	PT16	0.482688	0.4654603	0.4999157	0.5052219	0.5190144	0.4914294
Portugal	PT17	0.5203201	0.5748969	0.4657433	0.5052219	0.5190144	0.4914294
Portugal	PT18	0.3542778	0.3730825	0.3354732	0.5052219	0.5190144	0.4914294
Romania	RO11	0.5432566	0.5275595	0.5589538	0.5716204	0.522049	0.6211919
Romania	RO12	0.5884327	0.5983846	0.5784807	0.5716204	0.522049	0.6211919
Romania	RO21	0.5514333	0.4904417	0.6124249	0.5716204	0.522049	0.6211919

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Romania	RO22	0.5614011	0.4733165	0.6494856	0.5716204	0.522049	0.6211919
Romania	RO31	0.5410001	0.4744493	0.607551	0.5716204	0.522049	0.6211919
Romania	RO32	0.4902766	0.4552653	0.5252879	0.5716204	0.522049	0.6211919
Romania	RO41	0.5172383	0.4341993	0.6002772	0.5716204	0.522049	0.6211919
Romania	RO42	0.5790696	0.5477197	0.6104195	0.5716204	0.522049	0.6211919
Russia	RU11	0.6293679	0.6488416	0.6098943	0.623878	0.6547667	0.5929893
Russia	RU21	0.5906878	0.6332392	0.5481364	0.623878	0.6547667	0.5929893
Russia	RU31	0.6554288	0.7149363	0.5959213	0.623878	0.6547667	0.5929893
Russia	RU41	0.5550365	0.5765869	0.5334862	0.623878	0.6547667	0.5929893
Russia	RU51	0.5544084	0.6708903	0.4379266	0.623878	0.6547667	0.5929893
Russia	RU61	0.6007806	0.5994974	0.6020638	0.623878	0.6547667	0.5929893
Russia	RU71	0.6331052	0.5912103	0.675	0.623878	0.6547667	0.5929893
Russia	RU81	0.5921627	0.5801587	0.6041667	0.623878	0.6547667	0.5929893
Serbia	RS11	0.5124063	0.4889486	0.535864	0.5737382	0.5369175	0.6105588
Serbia	RS12	0.6296299	0.6089556	0.6503043	0.5737382	0.5369175	0.6105588
Serbia	RS21	0.5266995	0.4661767	0.5872224	0.5737382	0.5369175	0.6105588
Serbia	RS22	0.5759641	0.4856498	0.6662784	0.5737382	0.5369175	0.6105588
Slovakia	SK01	0.6465384	0.6694319	0.6236449	0.5970789	0.6315891	0.5625687
Slovakia	SK02	0.5574181	0.588783	0.5260532	0.5970789	0.6315891	0.5625687
Slovakia	SK03	0.5507872	0.5989215	0.5026529	0.5970789	0.6315891	0.5625687
Slovakia	SK04	0.606394	0.628504	0.584284	0.5970789	0.6315891	0.5625687

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Slovenia	SI03	0.5415521	0.5708435	0.5122607	0.5345785	0.5740629	0.4950941
Slovenia	SI04	0.5098957	0.5634333	0.4563581	0.5345785	0.5740629	0.4950941
Spain	ES11	0.5189514	0.6103401	0.4275627	0.6386095	0.7210922	0.5561268
Spain	ES12	0.4771623	0.6243926	0.329932	0.6386095	0.7210922	0.5561268
Spain	ES13	0.5596473	0.9029982	0.2162963	0.6386095	0.7210922	0.5561268
Spain	ES21	0.5149838	0.5668273	0.4631404	0.6386095	0.7210922	0.5561268
Spain	ES22	0.4798832	0.3741182	0.5856482	0.6386095	0.7210922	0.5561268
Spain	ES23	0.2762897	0.4900794	0.0625	0.6386095	0.7210922	0.5561268
Spain	ES24	0.5174153	0.7161458	0.3186849	0.6386095	0.7210922	0.5561268
Spain	ES30	0.6558227	0.6901261	0.6215193	0.6386095	0.7210922	0.5561268
Spain	ES41	0.6298286	0.6724572	0.5872	0.6386095	0.7210922	0.5561268
Spain	ES42	0.7260629	0.8099046	0.6422212	0.6386095	0.7210922	0.5561268
Spain	ES43	0.4502108	0.5514633	0.3489583	0.6386095	0.7210922	0.5561268
Spain	ES51	0.5945113	0.6676843	0.5213384	0.6386095	0.7210922	0.5561268
Spain	ES52	0.5225383	0.5873436	0.4577329	0.6386095	0.7210922	0.5561268
Spain	ES53	0.4596946	0.5563294	0.3630598	0.6386095	0.7210922	0.5561268
Spain	ES61	0.5540651	0.6024151	0.5057152	0.6386095	0.7210922	0.5561268
Spain	ES62	0.5038975	0.6368808	0.3709869	0.6386095	0.7210922	0.5561268
Spain	ES70	0.5125694	0.7238889	0.30125	0.6386095	0.7210922	0.5561268
Sweden	SE11	0.412879	0.4429286	0.3828294	0.4627492	0.4861977	0.4393007
Sweden	SE12	0.4567807	0.4612799	0.4522815	0.4627492	0.4861977	0.4393007

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Sweden	SE21	0.4937835	0.4834524	0.5041146	0.4627492	0.4861977	0.4393007
Sweden	SE22	0.4915627	0.5451095	0.4380159	0.4627492	0.4861977	0.4393007
Sweden	SE23	0.455029	0.4920522	0.4180057	0.4627492	0.4861977	0.4393007
Sweden	SE31	0.4796381	0.4655078	0.4937684	0.4627492	0.4861977	0.4393007
Sweden	SE32	0.4373979	0.4663468	0.408449	0.4627492	0.4861977	0.4393007
Sweden	SE33	0.4554632	0.4635414	0.447385	0.4627492	0.4861977	0.4393007
Switzerland	CH01	0.5182365	0.5984477	0.4380253	0.5142534	0.5851045	0.4434024
Switzerland	CH02	0.5151656	0.5861706	0.4441605	0.5142534	0.5851045	0.4434024
Switzerland	CH03	0.5076122	0.5599532	0.452712	0.5142534	0.5851045	0.4434024
Switzerland	CH04	0.4828427	0.5690851	0.3966004	0.5142534	0.5851045	0.4434024
Switzerland	CH05	0.5075039	0.5689093	0.4460985	0.5142534	0.5851045	0.4434024
Switzerland	CH06	0.5120063	0.5721104	0.4519022	0.5142534	0.5851045	0.4434024
Switzerland	CH07	0.5435263	0.5882074	0.4988452	0.5142534	0.5851045	0.4434024
Ukraine	UA11	0.5031987	0.5211713	0.4852262	0.6006954	0.6066989	0.5946919
Ukraine	UA12	0.3049355	0.2713294	0.3385417	0.6006954	0.6066989	0.5946919
Ukraine	UA13	0.40552	0.4178002	0.3932398	0.6006954	0.6066989	0.5946919
Ukraine	UA14	0.607731	0.5901157	0.6253463	0.6006954	0.6066989	0.5946919
Ukraine	UA21	0.4939236	0.4988426	0.4890046	0.6006954	0.6066989	0.5946919
Ukraine	UA22	0.6132572	0.6159702	0.6105442	0.6006954	0.6066989	0.5946919
Ukraine	UA23	0.4217607	0.494819	0.3487024	0.6006954	0.6066989	0.5946919
Ukraine	UA24	0.3344081	0.3505291	0.318287	0.6006954	0.6066989	0.5946919

Table 3 (continued)

Country name	NUTS-2 code	Overall RIL	Horizontal RIL	Vertical RIL	Overall country RIL	Horizontal country RIL	Vertical country RIL
Ukraine	UA31	0.5572562	0.5799546	0.5345578	0.6006954	0.6066989	0.5946919
Ukraine	UA41	0.2777778	0.2494331	0.3061225	0.6006954	0.6066989	0.5946919
Ukraine	UA42	0.5864778	0.6591146	0.5138409	0.6006954	0.6066989	0.5946919
Ukraine	UA43	0.4714135	0.4529317	0.4898953	0.6006954	0.6066989	0.5946919
Ukraine	UA51	0.5749986	0.5202395	0.6297578	0.6006954	0.6066989	0.5946919
Ukraine	UA52	0.4918597	0.4987811	0.4849383	0.6006954	0.6066989	0.5946919
Ukraine	UA53	0.4342857	0.4359788	0.4325926	0.6006954	0.6066989	0.5946919
Ukraine	UA61	0.5750272	0.5909277	0.5591266	0.6006954	0.6066989	0.5946919
Ukraine	UA62	0.6081108	0.6099991	0.6062226	0.6006954	0.6066989	0.5946919
Ukraine	UA63	0.6046745	0.6210653	0.5882835	0.6006954	0.6066989	0.5946919
Ukraine	UA71	0.5507615	0.5635416	0.5379813	0.6006954	0.6066989	0.5946919
Ukraine	UA72	0.5409275	0.5400121	0.5418429	0.6006954	0.6066989	0.5946919
Ukraine	UA73	0.3958333	0.2916667	0.5	0.6006954	0.6066989	0.5946919
Ukraine	UA81	0.5542801	0.5522639	0.5561963	0.6006954	0.6066989	0.5946919
Ukraine	UA82	0.5510637	0.3775904	0.724537	0.6006954	0.6066989	0.5946919
Ukraine	UA83	0.6312591	0.683842	0.5786762	0.6006954	0.6066989	0.5946919
Ukraine	UA84	0.4795429	0.4790857	0.48	0.6006954	0.6066989	0.5946919

**Table 4** Correlation matrix between RIL and: Gelfand tightness (2011), CTL from Uz (2015), Social capital and Political Polarization

	Horizontal RIL	Vertical RIL	Overall RIL
Gelfand tightness	− 0.3541	− 0.4557	− 0.4926
CTL domain specific	0.4471	− 0.2330	0.0904
CTL domain general	0.6092	0.3391	0.5549
CTL combination	0.0561	− 0.2059	− 0.1048
Overall social capital	− 0.1738	− 0.2058	− 0.2435
Bridging social capital	− 0.0472	0.0536	0.0056
Bonding social capital	− 0.0892	− 0.2915	− 0.2466
Political Polarization	− 0.1192	0.077	− 0.0352

of fairness, and the frequency of social interactions. PCA ensures that the resulting indicators are not driven by arbitrary weighting choices and provides a coherent synthesis of the underlying constructs. Details are presented in Appendix B. Incorporating these complementary measures allows us to test whether the RIL overlaps with network-based or relational dimensions of social capital, thereby strengthening the external validation of the index. Political polarization is operationalized with data from the EVS, as the share of people who in the left–right continuum placed themselves at the extremes (1–2 and 9–10).

Unfortunately, the RIL cannot be directly compared to the Huggins et al. (2025) constructs, for reasons of data availability, territorial coverage, and conceptual focus, while this highlights the broader relevance of cultural and behavioral structures in shaping territorial outcomes. In contrast to the emphasis on psychocultural profiles and institutional values suggested by Huggins and Thompson (2019) and Huggins et al. (2025), the RIL captures a different cultural dimension centred on normative homogeneity and tolerance for behavioral deviation, while the horizontal-vertical distinction introduces relational nuances absent from existing behavioral frameworks. This positions the RIL as a complementary contribution within the growing behavioral approach to regional development.

The very low levels of correlation between each of these variables and our three operationalizations of RIL presented in Table 4 suggest that the RIL does indeed measure a distinct dimension from social capital or political polarization.

To contextualise the cultural patterns we analyse, Table 5 reports descriptive statistics for key socio-economic characteristics of European NUTS-2 regions, including GDP per capita, population density, life expectancy, and share of population with a tertiary level education (data gathered from Eurostat, referred to 2017), and institutional quality indicators proxied through EQI and its pillars (Charron et al. 2019, data referred to 2017). These indicators provide a socio-spatial overview against which the distribution of the RIL can be compared, and allow to focus on its correlation with established cultural and institutional indicators rather than on unconditional descriptive statistics of contextual variables. The table highlights well-known economic gradients within Europe. GDP per capita exhibits essentially

**Table 5** Correlation matrix between RIL and Socioeconomic variables

	Horizontal RIL	Vertical RIL	Overall RIL
GDPpc	0.0468	− 0.1760	− 0.0859
Population Density	0.1152	− 0.0644	0.0290
Life Expectancy	0.2152	− 0.4263	− 0.1538
Population with tertiary education	0.1574	− 0.2931	− 0.0998

no association with horizontal looseness (0.0468) and an extremely moderate negative correlation with vertical looseness (− 0.1760). Population density displays essentially no systematic relation with either dimension (0.1006 and − 0.0513). Life expectancy correlates modestly positively with cultural looseness (0.2557) and negatively with political looseness (− 0.2827), while the share of the tertiary-educated population shows similarly weak associations (0.0452 and − 0.23). Overall, these results suggest that the RIL captures a cultural construct that is only loosely connected with the socio-economic structure of European regions, supporting the idea that looseness reflects normative configurations rather than economic development or demographic factors.

The evidence in Table 5 also clarifies how the RIL complements existing measures of cultural or social variation used in regional analysis. While national-level indices such as Gelfand's tightness-looseness scores or Uz's cultural looseness index capture broad cross-country tendencies, they mask the substantial within-country heterogeneity that emerges at the NUTS-2 level. Similarly, commonly employed cultural constructs (such as social capital) display only weak correlations with the RIL. This indicates that normative flexibility and tolerance for behavioral deviation constitute a distinct cultural attribute that is not reducible to trust-based, institutional, or network-structural explanations. Moreover, the horizontal-vertical decomposition of the RIL provides relational nuance that is not present in existing frameworks: horizontal looseness describes variation in peer-to-peer normative constraints, whereas vertical looseness captures variation in attitudes toward authority and norm enforcement. Together, these features position the RIL as a complementary tool for analysing regional cultural variation, enriching rather than substituting prevailing approaches.

Importantly, the inclusion of institutional indicators from the EQI does not alter this picture. Correlations with overall quality of government, impartiality, and corruption performance range from small to moderate with negative sign. These generally limited associations suggest that institutional performance does not mechanically translate into normative flexibility or rigidity at the regional level.

We then expanded the dataset to include more NUTS-2 regions. Unfortunately, Belgium, Germany, Greece, and Moldova do not report regional-level data in the EVS (2017), but only national-level data. This made it impossible to compute the RIL for the NUTS-2 regions of these countries. Given the importance of providing a dataset that includes these major European countries, and in the absence of alternative harmonised regional sources, we adopted a second-best strategy.

Specifically, building on the view that core cultural norms (particularly those related to social regulation and authority) display a substantial degree of medium-run persistence, we gathered data referring to the same survey items from the 2008 EVS wave and computed the RIL for the missing regions accordingly. This assumption is consistent with the economic literature on cultural persistence and intergenerational transmission of values (e.g., Giavazzi et al. 2019), while also acknowledging that cultural change may occur following major shocks.

Hence, data referring to Belgium, Germany, Greece, and Moldova are computed from the 2008 EVS wave rather than 2017. Figures 2 and 3 present heat maps with the deciles to which each European NUTS-2 region included in the sample belongs, with reference, respectively, to the horizontal and vertical dimensions of the RIL, and overall looseness.

At the same time, we explicitly recognize that the 2008–2017 period encompasses major economic and political shocks that may have affected specific cultural attitudes, especially those related to institutions and authority. For this reason, the use of mixed survey waves represents a pragmatic compromise rather than an ideal solution.

While this discrepancy does not affect the empirical applications reported in this article, since these regions do not enter the estimation samples due to listwise deletion induced by the control variables, it is important that scholars using the RIL in future analyses take this into account. Whenever the research design includes regions whose

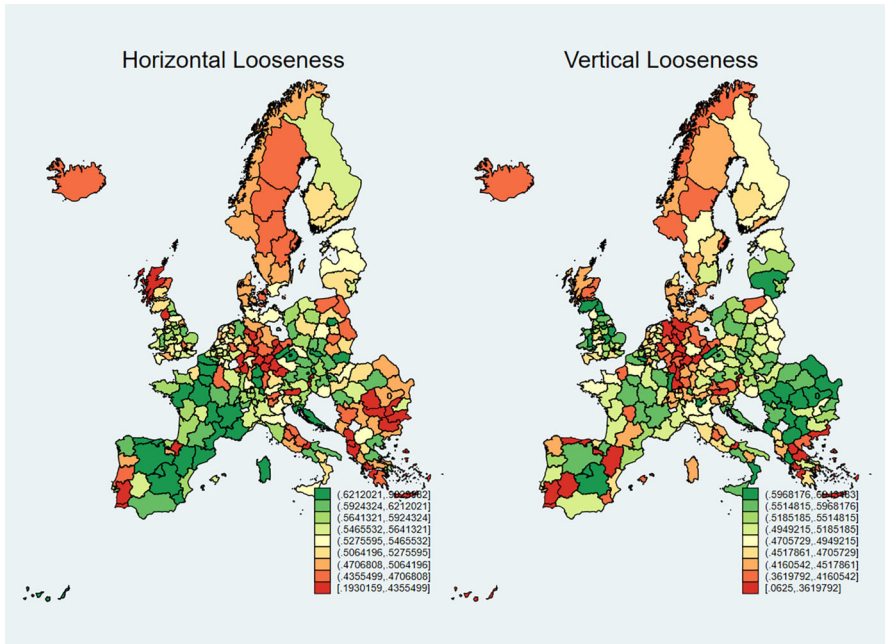
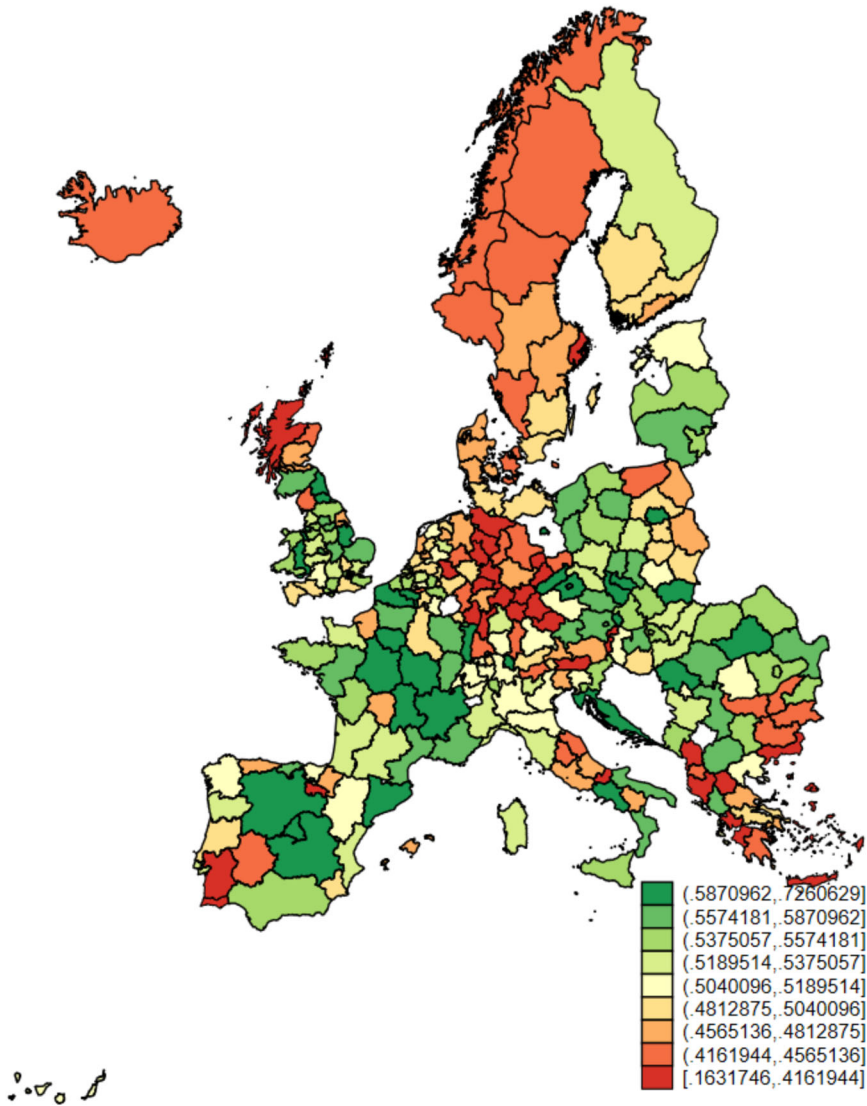


Fig. 2 Heat maps of horizontal and vertical looseness. Source: Authors' elaboration from data indicated in the article

## Overall Looseness



**Fig. 3** Heat map of overall looseness. Source: Authors' elaboration from data indicated in the article

RIL is computed from the 2008 data, appropriate robustness checks should be implemented to ensure that results are not mechanically driven by differences in reference years or by potential temporal drift in cultural attitudes. The RIL dataset therefore includes a flag identifying 2008-based regions to facilitate such exercises.

A further insight emerges from the spatial patterns displayed in the maps. The spatial distributions in Figs. 2 and 3 reveal distinct territorial patterns in the two dimensions of

looseness. Regions shaded in green display greater normative flexibility, while those in red exhibit tighter norms. Horizontal looseness shows a patchwork structure: certain French, Iberian, Dutch, and German regions appear to be among the loosest in Europe, whereas regions in Scandinavia, Central Europe, and Southern Italy tend to display tighter peer-level norms. Vertical looseness presents a different geography: regions in France, the Iberian Peninsula, the UK, and a belt running through Central Europe show relatively high tolerance for questioning or relaxing hierarchical expectations, while Scandinavian regions, Eastern Europe, and much of Italy emerge as comparatively tight. The overall looseness index confirms this heterogeneity, with clusters of high looseness dispersed across Western and Southern Europe and tighter norms prevailing in the Nordic countries and much of Central-Eastern Europe. These patterns underscore that horizontal and vertical looseness do not necessarily coincide spatially and capture distinct normative configurations, offering new insight into the cultural heterogeneity of European regions.

## 5 Associations Between the RIL and Health Behaviors

In this section, we propose two initial applications of the RIL, to offer an example of the possible uses of our novel dataset in the social sciences. All empirical analyses are exploratory and associational, and do not support causal inference.

### 5.1 The Association of Tightness and Looseness with Vaccination Choices

To give the readers an example of possible applications, we propose one application based on the association of a society's looseness on personal vaccination choice. As pointed out by previous contributions, in Europe vaccination choices are a highly politicized topic (Czarnek et al. 2020; Alfano and Ercolano 2022a), which could accordingly be assumed to be affected by our vertical dimension of looseness. We test this hypothesis with a regression analysis, using data from Eurobarometer 95.3 (European Commission 2022), a survey that reports, among other pieces of information, a variable indicating a respondent's intention not to get vaccinated.

Following the previous literature, we regress a dichotomous dummy variable, expressing the intention not to get vaccinated, on several individual-level determinants identified by previous literature as affecting the decision to get vaccinated (Alfano and Ercolano 2022a): age, marital status, education, gender, and working status. All these data are gathered from the Eurobarometer 95.3 (European Commission 2022). We also included on the right-hand side of the equation some regional-level (NUTS-2) determinants. These are GDP per capita, included to account for the different development levels of the EU regions, and life expectancy, to account for this important dimension of population health, both gathered from Eurostat and referred to 2017. We also included the EQI (Charron et al. 2019) to account for difference in institutional quality in NUTS-2 regions, as well as a core dichotomous dummy, to account for central versus peripheral EU regions. The distinction between core and peripheral regions is well established in regional science and EU territorial studies. Classic contributions

such as Myrdal (1957) and Friedmann (1966) describe how cumulative causation and spatial agglomeration generate structurally advantaged “cores” and lagging “peripheries.” In the European context, ESPON projects (1.1.1 and 1.1.4) formalise this divide by classifying regions according to accessibility, economic density, and integration into trans-European networks. Recent empirical work confirms persistent structural differences, with core regions displaying higher productivity, institutional capacity, and connectivity than peripheral ones (Rodríguez-Pose 2018). Using a core-periphery typology therefore offers a theoretically grounded way to assess whether the relationship between cultural looseness and pandemic-related behaviors varies across structurally distinct regional contexts. Finally, there is the RIL, in its three dimensions (each included in a separate regression), to test the association with regional looseness. Completing the specification is a matrix of country fixed effects, to account for any residual heterogeneity between European countries.

In more formal terms, we estimate the following cross-sectional model:

$$\Pr(\text{NoVax}_{ic} = 1) = F(\alpha + \beta \text{RIL}_c + \gamma X_{ic} + \delta Z_c) \quad (2)$$

where  $F(\cdot)$  denotes the cumulative distribution function appropriate to the estimator being used (standard normal for probit; logistic for logit), since the structure of the Eurobarometer data (a small number of individuals per cluster and no repeated measurements) makes a pooled model with clustered errors more appropriate;  $\text{NoVax}_{ic}$  is a dichotomous dummy variable equal to one if individual  $i$  in region  $c$  declares an intention not to get vaccinated,  $\text{RIL}_c$  is the regional looseness index (horizontal, vertical or overall, in separate models),  $X_{ic}$  is the vector of individual characteristics (age, gender, education, marital and employment status), and  $Z_c$  contains regional covariates (GDP per capita, population density, life expectancy, EQI, and being a core region). Standard errors are clustered at the country level.

The results of this operation, presented in Table 6 (with the use of a probit estimator) and Table 7 (using a logit estimator), suggest that in both cases the horizontal dimension (6.1 and 7.1), the vertical dimension (6.2 and 7.2), and the overall RIL (6.3 and 7.3) have a positive and statistically significant association on the decision not to get vaccinated. In other words, looser regional attitudes are associated with lower vaccination uptake.

From a theoretical perspective, this result is consistent with the interpretation of tightness-looseness as a regulatory dimension of culture: in looser regional contexts, greater tolerance for norm deviation and weaker sanctioning mechanisms increase the costs of achieving coordinated collective behavior, even in the presence of formal public health recommendations.

To explore whether the association between looseness and vaccination attitudes varies across the regional development spectrum, we modified Eq. (2) by adding an interaction term between the GDPpc and each of the three operationalizations of the RIL, and computing the marginal effects. Figures 4, 5, and 6 present the results of this exercise. While horizontal RIL presents the same association even at a different level of GDPpc, the association with vertical RIL is larger at higher levels of GDPpc. The same is true for overall RIL. As shown in Fig. 4, the marginal effect of horizontal looseness displays a flat profile, with marginal effects remaining modest throughout the GDPpc distribution and often not statistically different from zero.

**Table 6** Looseness and no intention to vax—Probit estimator

	(6.1)	(6.2)	(6.3)
	No intention to Vax	No intention to Vax	No intention to Vax
25–39	0.0924 (0.90)	0.0950 (0.92)	0.0952 (0.93)
40–54	0.0403 (0.33)	0.0417 (0.33)	0.0441 (0.36)
55–98	– 0.275** (– 2.22)	– 0.272** (– 2.19)	– 0.271** (– 2.18)
Married	– 0.169*** (– 5.93)	– 0.170*** (– 5.98)	– 0.170*** (– 5.98)
16–19	– 0.0268 (– 0.35)	– 0.0292 (– 0.38)	– 0.0283 (– 0.37)
20 +	– 0.223*** (– 2.95)	– 0.228** (– 2.93)	– 0.225*** (– 2.92)
Still studying	– 0.283*** (– 2.61)	– 0.284** (– 2.57)	– 0.282** (– 2.58)
No full– time education	0.342 (1.50)	0.357 (1.47)	0.351 (1.48)
Female	– 0.0727** (– 2.39)	– 0.0725** (– 2.39)	– 0.0721** (– 2.38)
Employed	– 0.00531 (– 0.09)	– 0.00132 (– 0.02)	– 0.00301 (– 0.05)
Not working	0.0632 (0.95)	0.0650 (0.98)	0.0654 (0.98)
EQI Index	– 0.0142 (– 0.13)	0.0370 (0.34)	0.0136 (0.12)
Reg.GDPpc	0.00000292 (0.68)	0.00000475 (1.44)	0.00000350 (0.95)
Reg.Life Exp	– 0.0737 (– 1.38)	– 0.0845* (– 1.81)	– 0.0805 (– 1.61)
Core dummy	0.203*** (2.88)	0.170** (2.37)	0.197*** (2.72)
Horizontal RIL	0.916** (2.25)		
Vertical RIL		0.868* (1.71)	
Overall RIL			1.261** (2.21)

**Table 6** (continued)

	(6.1)	(6.2)	(6.3)
Country Fixed Effects	YES	YES	YES
Constant	4.355 (1.01)	5.271 (1.38)	4.714 (1.15)
Observations	12,210	12,210	12,210
Pseudo $R^2$	0.094	0.094	0.095

*t* statistics in parentheses

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

Probit model on cross-sectional estimates. Standard errors clustered at the country level

On the other hand, Fig. 5 shows that for vertical RIL there is a positive association with the decision not to get vaccinated that grow markedly with regional income levels: in low-GDP regions the confidence intervals include zero, whereas in high-GDP regions the association becomes large and statistically significant. The marginal effects of the overall looseness index (Fig. 6) lie between the two, reflecting that the combined measure incorporates both the relatively stable cultural dimension and the more income-sensitive political one. These results indicate that the behavioral channel most sensitive to regional development is the vertical component of looseness, rather than peer-level normative flexibility. This pattern is consistent with institutional and political-economy perspectives, emphasizing that in more economically developed regions (where administrative capacity is relatively high and policy instruments are more sophisticated) behavioral outcomes increasingly depend on the legitimacy of authority and on culturally embedded norms regulating the relationship between citizens and institutions (Alesina and Giuliano 2015; Rodríguez-Pose 2018).

We further test whether the relationship differs between structurally advantaged and disadvantaged areas. Using the ESPON 1.1.1 and 1.1.4 core-periphery classification, we create a binary indicator equal to one for core regions. Interaction estimates between RIL and this indicator show pronounced heterogeneity (Figs. 7, 8, and 9). While looseness is positively associated with non-vaccination intention in both types of regions, the association is substantially larger and estimated with greater precision in core regions. In peripheral regions, confidence intervals are wide and overlap zero, suggesting weaker and more heterogeneous associations. This pattern is consistent with theories of cumulative causation and regional political mobilisation, whereby normative disagreement and trust-related behaviors matter more in structurally central regions. In this sense, cultural looseness interacts with territorial structure: where institutional density and political salience are higher, normative fragmentation translates more directly into heterogeneous responses to public policies.

The core-periphery results also differ across the looseness dimensions. For vertical looseness, the association with non-vaccination intention is substantially stronger and more precisely estimated in core regions, while peripheral regions show wide confidence intervals and weaker patterns. This is compatible with an interpretation that wants that authority-related normative flexibility plays a larger behavioral role

**Table 7** Tightness and no intention to vax—Logit model

	(7.1)	(7.2)	(7.3)
	No intention to Vax	No intention to Vax	No intention to Vax
25–39	0.173 (0.95)	0.177 (0.95)	0.177 (0.97)
40–54	0.0847 (0.38)	0.0847 (0.38)	0.0898 (0.41)
55–98	– 0.500** (– 2.17)	– 0.499** (– 2.17)	– 0.495** (– 2.15)
Married	– 0.310*** (– 5.62)	– 0.310*** (– 5.72)	– 0.310*** (– 5.68)
16–19	– 0.0716 (– 0.51)	– 0.0741 (– 0.52)	– 0.0734 (– 0.52)
20 +	– 0.433*** (– 3.19)	– 0.440*** (– 3.14)	– 0.437*** (– 3.15)
Still studying	– 0.547*** (– 2.75)	– 0.551*** (– 2.74)	– 0.545*** (– 2.74)
No full-time education	0.671 (1.52)	0.707 (1.48)	0.692 (1.49)
Female	– 0.139** (– 2.36)	– 0.140** (– 2.36)	– 0.138** (– 2.36)
Employed	– 0.00123 (– 0.01)	0.00717 (0.06)	0.00250 (0.02)
Not working	0.125 (0.97)	0.131 (1.02)	0.129 (1.00)
EQI Index	– 0.0398 (– 0.19)	0.0777 (0.36)	0.0182 (0.09)
Reg.GDPpc	0.0000503 (0.63)	0.0000890 (1.53)	0.0000600 (0.89)
Reg.Life Exp	– 0.138 (– 1.38)	– 0.158* (– 1.83)	– 0.150 (– 1.61)
Core dummy	0.471*** (3.49)	0.391*** (2.76)	0.460*** (3.32)
Horizontal RIL	1.896*** (2.79)		
Vertical RIL		1.848** (1.97)	
Overall RIL			2.637*** (2.61)

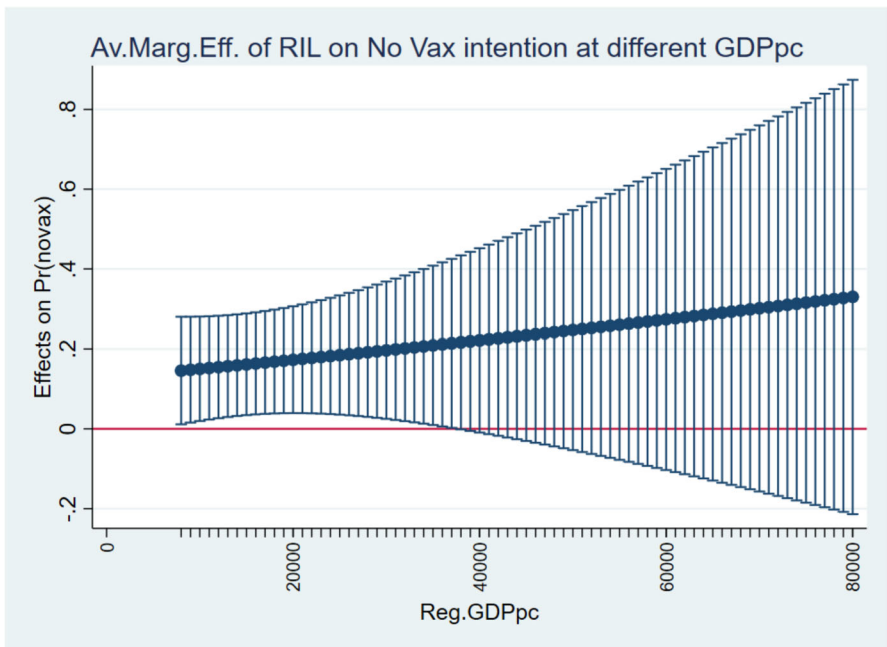
**Table 7** (continued)

	(7.1)	(7.2)	(7.3)
Country Fixed Effects	YES	YES	YES
Constant	8.241 (1.01)	9.862 (1.39)	8.718 (1.13)
Observations	12,210	12,210	12,210
Pseudo $R^2$	0.095	0.095	0.095

*t* statistics in parentheses

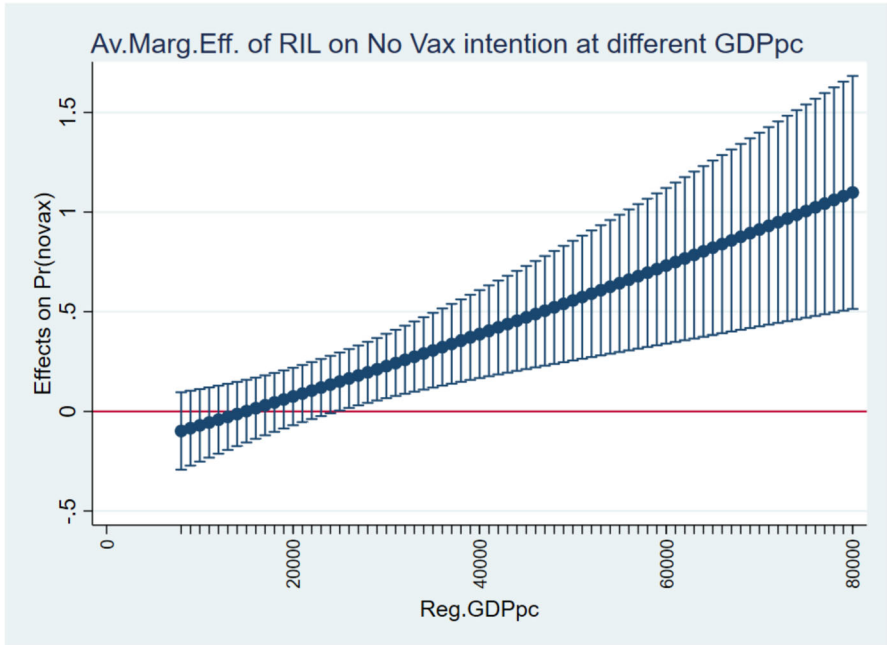
\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Logit model on cross-sectional estimates. Standard errors clustered at the country level



**Fig. 4** Average Marginal Effects of Horizontal RIL per different GDPpc levels. *Note* Confidence Intervals represent 90%. Source: Authors' elaboration from data indicated in the article

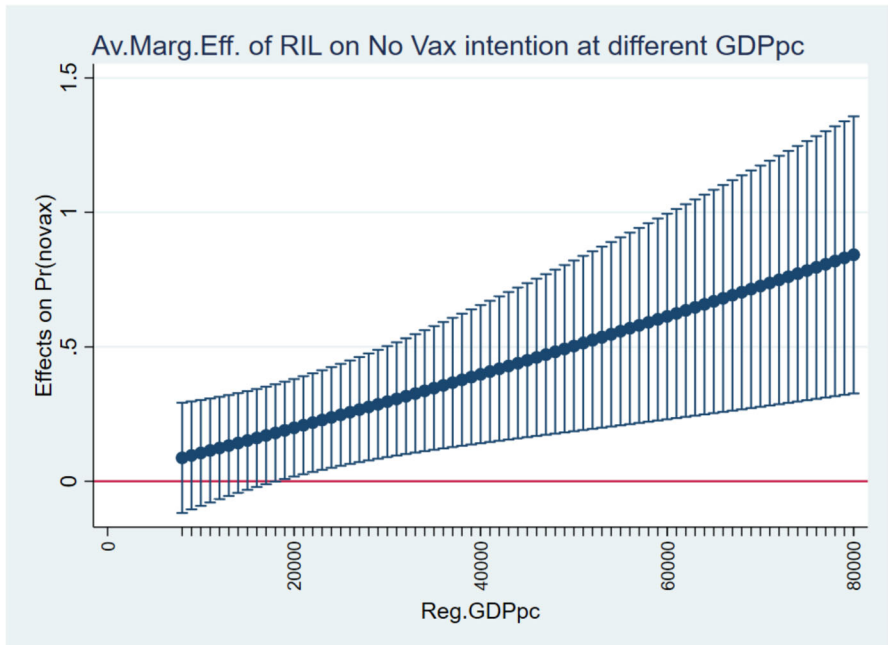
in structurally central, economically integrated regions. For horizontal looseness, the core-periphery contrast is more muted: estimates are positive in both types of regions but remain small and statistically imprecise. The overall looseness index reproduces an intermediate pattern, with a core-periphery difference that is clearer in the cultural component than it is in the political component. These results reinforce the idea that the two components of looseness capture different normative structures, with the political dimension being more exposed to contextual amplification in high-income or core regions.



**Fig. 5** Average Marginal Effects of Vertical RIL for different GDPpc levels. *Note* Confidence Intervals represent 90%. Source: Authors' elaboration from data indicated in the article

Taken together, these findings show that the heterogeneity in the association between RIL and the outcome is not uniform across its components. Vertical looseness, capturing tolerance towards questioning or relaxing authority, exhibits strong contextual modulation by economic development and regional centrality. Horizontal looseness, capturing peer-level behavioral flexibility, displays more stable coefficients across regional environments. The overall index reflects both these channels, but its heterogeneity patterns remain driven largely by the political dimension.

This finding is contrary to what was found (in a different context) by Jones et al. (2022). Their research, referred to the United States, and based on macro-level data on vaccination rates, found that cultural tightness is associated with lower vaccination rates against COVID-19; whereas we found that in the EU the regions characterized by looser societal attitudes, especially when it comes to its vertical dimensions, are populated by citizens who are more likely to refuse vaccination. Nonetheless, the pattern we observe resonates with the mechanism highlighted by Bazzi et al. (2021), who find that US counties with stronger individualistic and anti-statist cultural orientations were less willing to adopt collective responses to COVID-19. While their analysis relies on an exogenous historical determinant (frontier experience), our results emerge from variation in contemporary regional norms: regions characterised by greater looseness, and especially those high in vertical looseness, exhibit higher refusal of vaccination. This parallel strongly suggests that normative environments, whether historically rooted or contemporaneously measured, shape compliance with collective-action requirements.

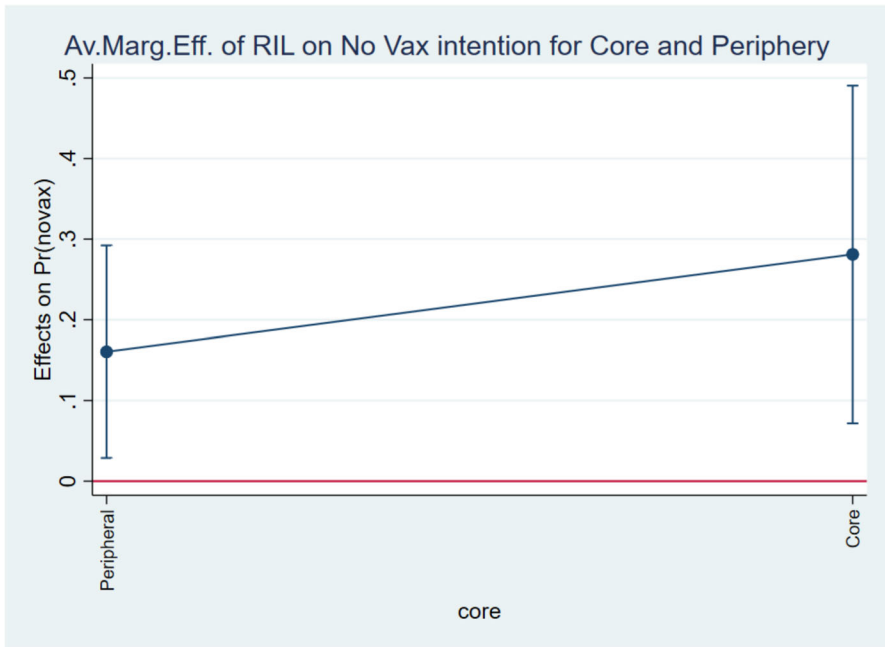


**Fig. 6** Average Marginal Effects of Overall RIL for different GDPpc levels. *Note* Confidence Intervals represent 90%. Source: Authors' elaboration from data indicated in the article

Crucially, our findings extend theirs offering a more fine-grained mapping of normative variation than is possible with a single-dimensional historical proxy. Overall, these findings support the view that cultural tightness-looseness captures an aspect of social cohesion that is distinct from, yet complementary to, traditional measures of social capital, by highlighting how the enforceability of norms conditions the effectiveness of institutional action.

## 5.2 The Association Between Tightness and Looseness and NPI Effectiveness

It has also been suggested that tightness and looseness may have an effect on NPI compliance (Gelfand et al., 2022), and through that channel on the evolution of the contagion trend. We test the association with the RIL on this dynamic by adapting a hybrid regression model (Allison 2009; Schunck 2013) for this case. This is a kind of modeling that is already widely used in the literature (Alfano 2022a and b), especially when there is a need to test the impact of a time-invariant variable on a daily panel modeling the trend of the pandemic. We regress the number of new daily cases of COVID-19 per capita once the vaccination campaign began and up to the onset of the summer of 2021, i.e. from 21 December 2020 to 30 June 2021, in each region for which data were available, building a panel dataset. Previous literature claims that the varying evolution of the case in a cross-country perspective might be considered as



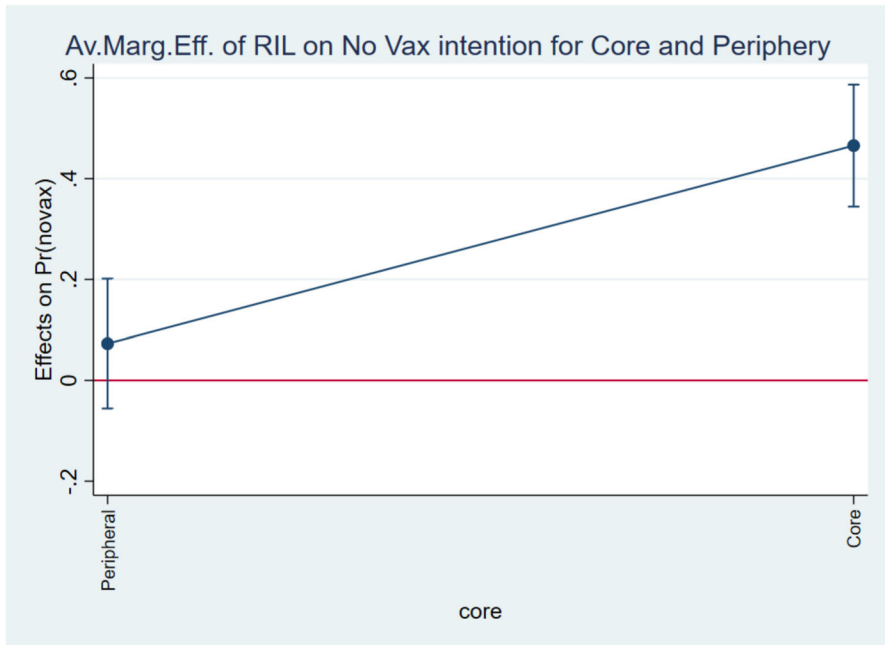
**Fig. 7** Average Marginal Effects of Horizontal RIL for core-peripheral regions. *Note* Confidence Intervals represent 90%. Source: Authors' elaboration from data indicated in the article

a proxy for the compliance of different publics with locally enforced NPIs (Alfano 2022a and 2022b; Alfano and Ercolano 2022b).

The analysis of the association between looseness and the effectiveness of NPIs exploits a daily region-level panel covering the period December 2020-June 2021. Because the RIL is time-invariant, following previous literature (Alfano 2022a and 2022b; Alfano and Ercolano 2022b) we adopt a correlated hybrid model that allows its inclusion while accounting for unobserved regional heterogeneity. In more formal terms, we estimated:

$$\begin{aligned}
 \Delta i_{rt} = & \alpha + \beta_1(i_{rt-1} - \bar{i}_r) + \beta_2\bar{i}_r \\
 & + \beta_3(Str_{ct-28} - \overline{Str}_c) + \beta_4\overline{Str}_c \\
 & + \beta_5RIL_r + \beta_6AvAge_r + \beta_7GDPPc_r \\
 & + \beta_8PopDens_r + \beta_9ShVaX_r + \beta_{10}T_t + \varepsilon
 \end{aligned}
 \tag{3}$$

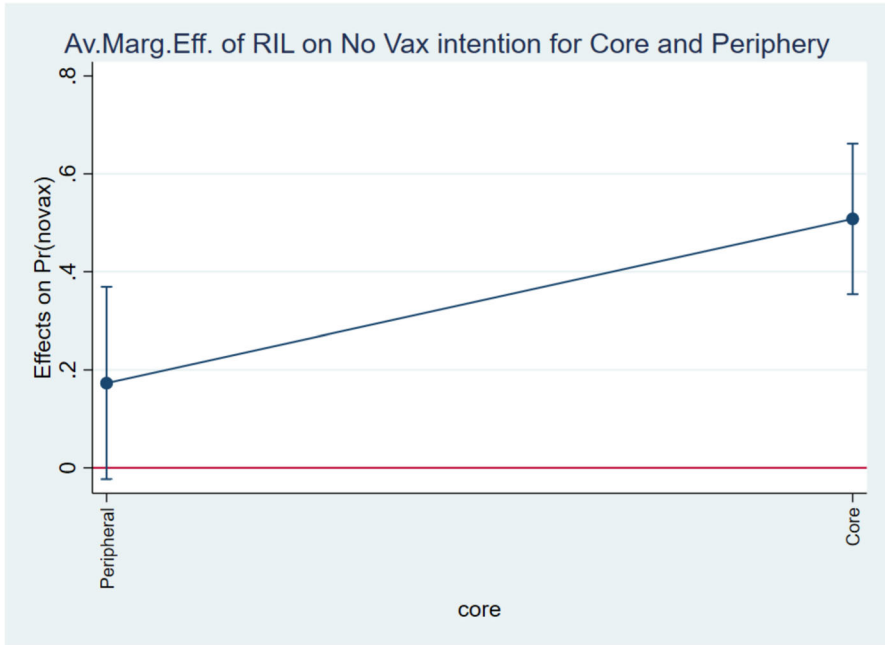
where  $\Delta i_{rt}$  represents the number of new COVID-19 cases recorded in region  $r$  on day  $t$  (NEWCases), while  $i_{r(t-1)}$  (TOTALCases) denotes the cumulative number of infections on the previous day, included to account for the exponential dynamics of viral transmission (these first two variables gathered from Naqvi 2021). As usual in hybrid models, this variable is decomposed into its within region part (the difference from the region mean of each observation  $i_{rt-1} - \bar{i}_r$ ) and between region part (each



**Fig. 8** Average Marginal Effects of Vertical RIL for core-peripheral regions. *Note* Confidence Intervals represent 90%. Source: Authors' elaboration from data indicated in the article

region mean,  $\bar{i}_r$ ). STR captures the set of NPI adopted in the country sufficiently in advance (28 days before, Alfano 2022b; Alfano and Ercolano 2022b) for their effects to manifest (data gathered from the Oxford Stringency Index, Hale et al. 2020), once again decomposed into its two parts.  $RIL_r$  measures our index in its three different operationalizations. We also included: average regional age, regional GDP per capita (both gathered from Eurostat and referred to 2017), the population density of the region (gathered from Naqvi 2021), and the share of population vaccinated in region  $r$  (data from the Vaccine Tracker of the European Center of Disease Prevention and Control). Finally, there is a matrix of monthly time dummies to absorb temporal shocks and common trends. In this framework, the coefficient on looseness,  $\beta_5$ , identifies the association between RIL and the progression of the pandemic, that is, the additional number of cases experienced by countries where the region is more loose.

By estimating this equation, we aimed to check the possible association of horizontal, vertical, or overall looseness on the daily number of cases (which can be explained through varying compliance with the NPIs). Our results, presented in Table 8, suggest that once again both vertical and overall dimensions of looseness are associated with the number of new cases, which can be explained by differences in cross-country NPI compliance. More precisely, higher looseness is associated with higher daily case counts, a finding in line with what was found by Gelfand et al. (2021) in their cross-country analysis. This evidence is consistent with theoretical accounts that emphasize



**Fig. 9** Average Marginal Effects of Overall RIL for core-peripheral regions. *Note* Confidence Intervals represent 90%. Source: Authors' elaboration from data indicated in the article

how weaker normative enforcement reduces the capacity for sustained collective compliance, thereby limiting the effectiveness of institutional interventions even when formal restrictions are in place.

The results also resonate once again with the mechanism highlighted by Bazzi et al. (2021), who show that US counties with stronger individualistic and anti-statist cultural orientations displayed weaker adherence to collective public-health measures during the pandemic. Whereas their analysis identifies a historical source of contemporary cultural traits, our findings capture how present-day regional norms translate into differential responsiveness to NPIs: regions characterised by higher looseness, and in particular by higher vertical looseness, are associated with a weaker epidemiological impact of restrictive policies. This parallel again suggests that normative environments, whether historically transmitted or contemporaneously observed, condition the capacity for coordinated collective action under public-health stress. At the same time, our results extend those of Bazzi et al. (2021) by documenting how the political (vertical) dimension of looseness plays a disproportionately large role in shaping compliance, thus offering a more granular account of the normative channels through which cultural heterogeneity influences policy effectiveness.

**Table 8** Looseness association with NPI compliance—Hybrid Model

	(8.1)	(8.2)	(8.3)
YCases pc within	New Cases pc - 0.0191*** (- 15.88)	New Cases pc - 0.0194*** (- 16.14)	New Cases pc - 0.0194*** (- 16.61)
YCases pc between	0.00355*** (7.14)	0.00359*** (9.42)	0.00354*** (8.13)
L28.Str.Within	- 0.0822 (- 0.70)	- 0.0736 (- 0.63)	- 0.0756 (- 0.64)
L28.Str.Between	0.0985 (1.55)	0.0730 (0.91)	0.0996 (1.44)
Average Age	- 0.714* (- 1.65)	- 0.644 (- 1.38)	- 0.693 (- 1.51)
LogGDPpc	1.334* (1.94)	1.633 (1.39)	1.689** (2.03)
Pop.Dens	- 0.0120** (- 2.29)	- 0.0117** (- 2.12)	- 0.0125** (- 2.38)
L28.Sh.Tot.Vax_within	- 8.926** (- 2.25)	- 8.574** (- 2.23)	- 8.629** (- 2.23)
L28.Sh.Tot.Vax_between	13.42 (0.64)	13.03 (0.79)	13.67 (0.70)
Horizontal Looseness	7.995 (0.95)		
Vertical Looseness		13.50***	

**Table 8** (continued)

	(8.1)	(8.2)	(8.3)
Overall Looseness		(7.22)	14.58** (1.98)
Constant	3.003 (0.27)	- 3.627 (- 0.36)	- 4.690 (- 0.54)
Observations	4089	4089	4089

*t* statistics in parentheses.  
 \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Hybrid model panel estimates. Standard errors clustered at the country level

## 6 Conclusions

This study introduces the Regional Index of Looseness as a novel tool for measuring cultural looseness within the context of NUTS-2 level regions, both in its horizontal and in its vertical dimensions. To the best of our knowledge, this study is the first attempt to measure looseness at the regional level that distinguishes between its horizontal and vertical dimensions. The preliminary applications of these indexes presented in the previous sections underscore their potential utility in increasing our understanding of cultural influence in risk management processes.

Building upon the extensive literature on this subject, our study provides a regional perspective, recognizing the importance of within-country variations in cultural dynamics. The findings reveal intriguing insights into the association of cultural looseness with critical aspects of societal behavior, particularly with two applications in the context of the COVID-19 pandemic. Notably, our analysis reveals that the level of cultural tightness or looseness within a region is correlated with both vaccination attitudes and the effectiveness of NPIs. This underscores the importance of considering cultural factors in the design and implementation of public policies, especially in situations involving global risks. Our findings indicate that, within the European context, the decision to undergo vaccination is a highly politicized issue. Regions characterized by vertical looseness exhibit a higher likelihood of vaccine hesitancy. This result aligns with the existing literature suggesting that, in the European context, vaccination decisions are influenced by specific political factors. Moreover, we found that the number of daily cases is higher in looser regions, a result in line with the idea that people are less likely to comply with NPIs in regions where the norms are less enforced, and hence less effective in curbing contagion and reducing the number of new cases.

Furthermore, our study identifies the existence of distinct sub-dimensions of tightness and looseness (horizontal and vertical) that offer a more nuanced understanding of how cultural norms shape individual and collective decision-making. Neither of these dimensions, or the overall RIL, are correlated to operationalizations of the main socio-economic constructs, social capital or political polarization. This suggests the importance of the RIL, at least when it comes to measuring a different dimension from the popular constructs already used in social science research. By providing a regional-level perspective and exploring multiple dimensions of cultural looseness, this study contributes to our understanding of the role of culture in shaping responses to external shocks, and offers valuable insights for policymakers, scholars, and practitioners alike.

Beyond its descriptive and analytical contribution, the Regional Index of Looseness provides concrete guidance for public policy design and territorial governance. By capturing cross-regional variation in the strength and enforceability of social norms, the RIL enables policymakers to anticipate differences in compliance costs and coordination capacity across regions. Specifically, our findings suggest that in regions characterized by high vertical looseness, where authority-related norms are more flexible and contested, top-down regulatory interventions are likely to encounter greater resistance and require more substantial investments in communication, legitimacy-building, and trust-enhancing strategies.

Conversely, in tighter regional contexts, policies based on clear rules and centralized enforcement tend to be more effective, though they may carry risks of rigidity and reduced adaptability. In this respect, the distinction between horizontal and vertical looseness proves particularly informative, as it allows for differentiation between peer-driven normative flexibility and authority-related contestation. This differentiation can guide more calibrated policy approaches: for instance, by combining enforcement mechanisms with participatory or deliberative tools in regions with high vertical looseness. More broadly, the RIL offers an instrument for integrating cultural considerations into place-based policy frameworks, thereby contributing to a more nuanced understanding of territorial governance and institutional effectiveness.

In conclusion, our study underscores the significance of cultural looseness not only as an analytical construct, but also as an important dimension for understanding territorial governance and policy effectiveness in European NUTS-2 regions. It introduces a unique perspective by separating the horizontal from the vertical dimension, and highlights the importance of considering these cultural factors in managing global risks. Further research into this domain promises to provide valuable insights into the dynamics of decision-making in different cultural contexts: future studies may focus on different areas, or on the temporal dimension. Another avenue for future research concerns the use of machine-learning algorithms to explore the determinants of the RIL. Techniques such as random forests or gradient-boosting models could offer a data-driven assessment of which regional characteristics most strongly predict cultural looseness, complementing the exploratory analyses presented here. Implementing such methods lies beyond the scope of the present study, but these offer a promising direction for expanding the empirical understanding of regional normative structures.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s40797-026-00382-5>.

**Funding** Open access funding provided by Università Parthenope di Napoli within the CRUI-CARE Agreement. No funding was received to perform this research.

## Declarations

**Conflict of interest** Neither author perceives any conflict of interest.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

- Aktas M, Gelfand MJ, Hanges PJ (2016) Cultural tightness–looseness and perceptions of effective leadership. *J Cross Cult Psychol* 47(2):294–309
- Alesina A, Giuliano P (2015) Culture and institutions. *J Econ Lit* 53(4):898–944
- Alfano V (2022a) Does social capital enforce social distancing? The role of bridging and bonding social capital in the evolution of the pandemic. *Econ Polit* 39:839–859
- Alfano V (2022b) Work ethics, stay-at-home measures and COVID-19 diffusion. *Eur J Health Econ* 23:893–901
- Alfano V, Ercolano S (2022a) Your vaccine attitude determines your altitude. What are the determinants of attitudes toward vaccination? *Vaccine* 40(48):6987–6997
- Alfano V, Ercolano S (2022b) Stay at home! governance quality and effectiveness of lockdown. *Soc Indic Res* 159:101–123
- Allison PD (2009) Fixed effects regression models. Thousand Oaks, CA: Sage
- Au KY (2000) Intra-cultural variation as another construct of international management: a study based on secondary data of 42 countries. *J Int Manag* 6:217–238
- Basabe N, Ros M (2021) Cultural dimensions and social behavior correlates during the COVID-19 pandemic: horizontal and vertical individualism and collectivism. *Int J Soc Psychol* 36(2):234–252
- Bazzi S, Fiszbein M, Gebresilasie M (2021) “Rugged individualism” and collective (In)action during the COVID-19 pandemic. *J Public Econ*. <https://doi.org/10.1016/j.jpubeco.2020.104357>
- Berry KJ, Mielke PW Jr. (1992) Assessment of variation in ordinal data. *Percept Mot Skills* 74:63–66
- Biddlestone M, Green R, Douglas KM (2020) Cultural orientation, power, belief in conspiracy theories, and intentions to reduce the spread of COVID-19. *Br J Soc Psychol* 59(3):663–673
- Blair J, Lacy MG (2000) Statistics of ordinal variation. *Sociol Methods Res* 28(3):251–280
- Chan DKS, Gelfand MJ, Triandis HC, Tzeng O (1996) Tightness-looseness revisited: a systematic examination in Japan and the United States. *Int J Psychol* 31(1):1–12
- Chan HCY, Zhang H, Weng CL (2020) Collectivism predicts preventive behaviors towards COVID-19 through self-sacrifice intentions. *Personality Individ Differ* 166:110199
- Charron N, Lapuente V, Annoni P (2019) Measuring quality of government in EU regions across space and time. *Pap Reg Sci*. <https://doi.org/10.1111/pirs.12437>
- Czarnek G, Kossowska M, Szwed P (2020) Political ideology and attitudes toward vaccination: a study report. Working paper
- Denti D, Crociata A, Faggian A (2023) Knocking on Hell’s door: dismantling hate with cultural consumption. *J Cult Econ* 47:303–349
- Dijkstra L, Poelman H, Rodríguez-Pose A (2020) The geography of EU discontent. *Reg Stud* 54(6):737–753
- European Social Survey (ESS) (2018) ESS Round 9: European Social Survey Round 9 Data. Data archived and distributed by the Norwegian Centre for Research Data (NSD). <https://doi.org/10.21338/NSD-ESS9-2018>
- European Commission. (2022). Eurobarometer 95.3: Public opinion in the European Union. European Commission, Brussels
- Gannon B, Roberts J (2020) Social capital: exploring the theory and empirical divide. *Empir Econ* 58(3):899–919
- Geeraert N, Li R, Ward C, Gelfand M, Demes KA (2019) A tight spot: how personality moderates the impact of social norms on sojourner adaptation. *Psychol Sci* 30(3):333–342
- Gelfand MJ (2011) Differences between tight and loose cultures: a 33-nation study. *Sci* 333(6045):937–937
- Gelfand MJ (2019b) Universal and culture-specific patterns of tightness-looseness across the 31 Chinese provinces. *Proc Natl Acad Sci U S A* 116(14):6522–6524
- Gelfand MJ, Nishii LH, Raver JL (2006) On the nature and importance of cultural tightness-looseness. *J Appl Psychol* 91(6):1225
- Gelfand MJ, Harrington JR, Jackson JC (2017) The strength of social norms across human groups. *Perspect Psychol Sci* 12(5):800–809
- Gelfand MJ, Harrington JR, Jackson JC (2022) The strength of social norms across human groups. *Perspect Psychol Sci* 17(1):108–123
- Gelfand MJ, Jackson JC, Pan X, Nau D, Pieper D, Denison E, Wang M (2021) The relationship between cultural tightness–looseness and COVID-19 cases and deaths: a global analysis. *Lancet Planetary Health* 5(3):e135–e144

- Gelfand M, Jackson JC, Pan X, Nau DS, Dagher MM, van Lange P, Chiu CY (2020) The importance of cultural tightness and government efficiency for understanding COVID-19 growth and death rates
- Gelfand M (2019) Rule makers, rule breakers: tight and loose cultures and the secret signals that direct our lives. Scribner
- Giavazzi F, Petkov I, Schiantarelli F (2019) Culture: persistence and evolution. *J Econ Growth* 24(2):117–154. <https://doi.org/10.1007/s10887-019-09166-2>
- Harding S, Phillips D (1986) *Contrasting values in Western Europe. Unity, diversity and change.* Macmillan, London
- Harrington JR, Gelfand MJ (2014) Tightness–looseness across the 50 united states. *Proc Natl Acad Sci* 111(22):7990–7995
- Hale T, Angrist N, Goldszmidt R, Kira B, Petherick A, Phillips T, Tatlow H (2020) A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). *Nature Human Behaviour* 5:529–538
- Hofstede G (1980) Culture and organizations. *Int Stud Manag Org* 10(4):15–41
- Huggins R, Thompson P (2019) The behavioral foundations of urban and regional development: culture, psychology and agency. *J Econ Geogr* 19(1):121–146
- Huggins R, Dixon L, Thompson P (2025) The behavioral-institutional dimensions of regional development: values, personality psychology, and culture. *Eur Plan Stud* 33(12):2207–2235
- Huynh TLD (2020) The COVID-19 risk perception: a cross-cultural analysis. *Int J Sociol Soc Policy* 40(9/10):1041–1056
- Iammarino S, Rodriguez-Pose A, Storper M (2019) Regional inequality in Europe: evidence, theory and policy implications. *J Econ Geogr* 19(2):273–298
- Jackson JC, Gelfand M, Ember CR (2020) A global analysis of cultural tightness in non-industrial societies. *Proc R Soc B Biol Sci* 287(1930):20201036
- Jiang S, Wei Q, Zhang L (2022) Individualism versus collectivism and the early-stage transmission of COVID-19. *Soc Indic Res* 164(2):791–821
- Jin Y, Bai S, Han T, Li L, Xie T, Guo Y, Zhang RJ (2024) Interdependency or submission to authority? The impacts of horizontal and vertical collectivist orientation on vaccine attitudes in mainland China. *Int J Psychol.* <https://doi.org/10.1002/ijop.13217>
- Jones J, Trombley TE, Trombley MP (2022) Impact of cultural tightness on vaccination rate. *Risk Manag Insur Rev* 25(3):367–389
- Kyne D, Aldrich DP (2020) Capturing bonding, bridging, and linking social capital through publicly available data. *Risk Hazards Crisis Public Policy* 11:61–86
- Li R, Gordon S, Gelfand MJ (2017) Tightness–looseness: a new framework to understand consumer behavior. *J Consum Psychol* 27(3):377–391
- Lu JG, Jin P, English AS (2021a) Collectivism predicts mask use during COVID-19. *Proc Natl Acad Sci* 118(23):e2021793118
- Lu JG, Nisbett RE, Morris MW (2021b) Cultural tightness and individualism/collectivism in COVID-19 responses: how vertical and horizontal dimensions shape compliance. *J Pers Soc Psychol* 120(5):1025–1045
- Maaravi Y, Levy A, Gur T, Confino D, Segal S (2021) The tragedy of the commons: how individualism and collectivism affected the spread of the COVID-19 pandemic. *Front Public Health* 9:627559
- Matsumoto D, Hwang HC, Yoo SH (2021) The influence of cultural dimensions on COVID-19 response: Vertical and horizontal individualism/collectivism in different societal contexts. *Asian Journal of Social Psychology*, 24(2), 98–108.
- Minkov, M., Blagoev, V., Hofstede, G. (2013). The boundaries of culture: Do questions about societal norms reveal cultural differences? *J Cross Cult Psychol* 44:1094–1106
- Minkov M, Bond MH, Dutt P, Schachner M, Morales O, Sanchez C, Mudd B (2013) A reconsideration of Hofstede’s fifth dimension: new evidence from the World Values Survey. *J Cross-Cult Psychol* 44(7):1097–1116
- Myrdal G (1957) *Economic theory and under-developed regions.* Duckworth, London
- Naqvi A (2021) COVID-19 European regional tracker. *Sci Data* 8(1):181
- Pelto PJ (1968) The differences between “tight” and “loose” societies. *Trans-Action* 5:37–40
- Putnam RD (2000) *Bowling alone: The collapse and revival of American community.* Simon & Schuster, New York, NY
- Realo A, Koido K, Ceulemans E, Allik J (2021) The role of vertical and horizontal cultural dimensions in COVID-19 responses: an international comparison. *J Cross Cult Psychol* 52(7):652–668

- Rodríguez-Pose A (2018) The revenge of the places that don't matter (and what to do about it). *Camb J Reg Econ Soc* 11(1):189–209. <https://doi.org/10.1093/cjres/rsx024>
- Schunck R (2013) Within and between estimates in random-effects models: advantages and drawbacks of correlated random effects and hybrid models. *Stata J* 13(1):65–76
- Stamkou E, van Kleef GA, Homan AC, Gelfand MJ, van de Vijver FJ, van Egmond MC, Lee IC (2019) Cultural collectivism and tightness moderate responses to norm violators: effects on power perception, moral emotions, and leader support. *Personal Soc Psychol Bull* 45(6):947–964
- Triandis HC (1995) *Individualism and Collectivism*. Westview Press
- Triandis HC, Gelfand MJ (1998) Converging measurement of horizontal and vertical individualism and collectivism. *J Pers Soc Psychol* 74(1):118
- Uz I (2015) the index of cultural tightness and looseness among 68 countries. *J Cross Cultural Psychol* 46(3):319–335
- Vauclair C, Fischer R (2011) Do cultural values predict individuals' moral attitudes? A cross-cultural multilevel approach. *Eur J Soc Psychol* 41:645–657
- Vignoles VL, Owe E, Becker M, Smith PB, Easterbrook MJ, Brown R, Alvarez B (2021) Beyond individualism-collectivism: cultural orientations, vertical and horizontal social norms, and COVID-19. *Nat Hum Behav* 5(1):90–101
- Woolcock M (1998) Social capital and economic development: toward a theoretical synthesis and policy framework. *Theory Soc* 27(2):151–208

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.