STUDIES

Territorial capital in the European Union: Measuring the territorial endowments of the EU-28 NUTS* 2 regions over the 2010s

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Territorial capital encompasses all tangible and intangible assets that represent the growth potential of a place. This study reviews the concept of territorial capital and highlights its components. A database of territorial capital indicators for 270 regions of the European Union at the NUTS 2 level is employed, and a classification of regions based on the material and non-material assets of territorial capital is presented. Mapping differences across regions provides insight into the key dimensions of territorial capital, namely the material resource endowment, non-material resource endowment, and material–non-material asset relations. The results reveal that European regions have been differently endowed with territorial capital during the 2010s; a sharp divide is visible between the Western and Eastern European regions, according to the degree of urbanisation and according to the relative development of regions. The findings of this study have the potential to contribute significantly to the ongoing discussion and evolving research on territorial capital.

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* NUTS is Nomenclature of territorial units for statistics (French: *Nomenclature des unités territoriales statistiques*). It is a geocode standard for referencing the subdivisions of countries for statistical purposes.

Introduction

During the past 10 years, various aspects of territorial capital have been among the most popular research issues in regional science, especially regional economics and policy. New perspectives have been opened for a conceptual breakthrough towards the relatively new concept of territorial capital, by polishing the fundamental points about why firms in the same industry congregate, often associated these days with the phrase 'something in the air', inherited from the Marshallian tradition (Marshall 1890), reiterated in *Territorial Outlook* published by the Organisation for Economic Co-operation and Development (OECD), defined as 'the outcome of a combination of institutions, rules, practices, producers, researchers and policy makers that make a certain creativity and innovation possible' (OECD 2001: 15., Camagni 2008: 36–37.).

The concept of territorial capital became popular during the 2000s, when regional science and European regional policy were blossoming in one of their most exciting epochs. First, a cognitive and regional approach to territorial development has superseded the traditional functional approach by highlighting the importance of complex, inter-subjective relationships that enable economic agents to perceive economic reality, be receptive to external stimuli, react creatively, cooperate, and work synergistically (Camagni 2008, Camagni–Capello 2013). Accordingly, territories have recently been conceived as multidimensional spaces, where economic, social, environmental, cognitive, and other dimensions are related to each other, generating huge and diversified cross-externalities and synergy effects, as well as determining the growth potential of places and regions (Camagni 2017).

In addition, territorial capital has gained considerable attention as the new theories and approaches of endogenous development, as well as the endogenous sources of competitiveness, enriched economic theory by highlighting the role of intangible elements (e.g. human capital, relational, and social capital) in determining local competitiveness (Capello et al. 2011, Camagni–Capello 2013, Jóna 2015, Capello 2016, Morretta 2021, Tésits et al. 2021). It has become common to bring up diverse forms of capital in regional science, partly taken from other fields of social sciences, and currently, various forms of capital are often thought of as developing in a sentient organism, as well as regarded as the true source of the endogenous development of regions (e.g. Kitson et al. 2004, Emery–Flora 2006, Agarwal et al. 2009, Stimson et al. 2011, Carayannis et al. 2012). The 'quasi-production function' has lost its capacity as an ideal production function with heterogeneous capital assets emerging. This scientific trajectory has positioned the concept of territorial capital, which includes a full spectrum of tangible (e.g. material natural and cultural heritage, artificial public goods, private capital goods) and intangible (e.g. non-material human and cognitive capital, identitarian capital, social capital, relational capital) goods and assets, which serve as good measures as well as proxies (Camagni 2017). The theoretical achievements also lie in the possibility of bridging the gap between mainstream

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macroeconomic growth theory and heterodox economic growth theory, as well as bridging the two policy visions, represented by competitiveness (efficiency) and cohesion (equity) goals (Camagni 2019).

Furthermore, the issue has become particularly important in the regional policy context – especially in territorial development policies (policies with a territorial approach to development) to help areas develop (e.g. LEADER EO 1999, OECD 2001, EC 2005, 2011), as well as in modern place-based approaches to regional policy (Barca 2009, 2011) that emphasise the formation of policy tools (OECD 2009, Harfst et al. 2020) as a mix of hard capital and soft capital (McCann 2013, Zasada 2015), which – accumulating over time across different territories – becomes a source of competitive advantage (Morretta et al. 2020).

Policy documents have stressed the peculiar nature of territorial capital. The first important contribution was proposed by the LEADER (1999: 19.) European Observatory by emphasising that territorial capital is 'intended to identify the distinctive features of an area' in order to initiate territorial development strategies. Nonetheless, the OECD's contribution might be regarded as a major 'jumping-off point' that gave impetus for further investigations into territorial capital by suggesting that each area should make best use of the stock of assets that forms the basis for endogenous development (OECD 2001: 13.). The term was recapped by the European Commission as follows: '[e]ach region has a specific territorial capital that is distinct from that of other areas and generates a higher return for specific kinds of investments than for others, since these are better suited to the area and use its assets and potential more effectively' (EC 2005: 3. based on OECD 2001: 15–16.).

Although the current study is not aimed at providing an exhaustive review of the literature on the evolution of the concept and measurement of territorial capital, as reviews of this nature are already available (Tóth 2015, 2017), it is worth mentioning that there have been a few pioneering studies seeking to define and conceptualise territorial capital, as well as how to measure it (e.g. Camagni 2008, 2019, Affuso– Camagni 2010, Capello et al. 2011, Brasili et al. 2012, Camagni–Capello 2013, Lo Cascio et al. 2013, Perucca 2014, Martinoia–Pompili 2015, Fratesi–Perucca 2018, 2019, Mazzola et al. 2018, Castelnovo et al. 2020, Benassi et al. 2021, Morretta et al. 2020, Morretta 2021). However, the incorporation of territorial capital into empirical work is still at an early stage (Camagni 2017); therefore, empirical evidence is limited, and the research topic deserves further inspection. Accordingly, further in-depth analysis of the data might provide a more diversified picture of territorial capital. Although Fratesi–Perucca (2019) examined the territorial capital endowments of the EU-15 NUTS regions based on data from the 2000s, to the best of my knowledge, no study has explored the territorial capital endowment across European regions to date.

The primary aim of this study is to present empirical evidence through the measurement of some of the components of territorial capital using principal

component analysis and cluster analysis techniques. I build on the argument that measurement of territorial capital is essential for a better understanding of the diversity of EU regions. When developing this argument, I investigate the components of territorial capital through a thematic categorisation elaborated by Roberto Camagni, the pioneer of the concept. On the one hand, particular attention is paid to the identification of the key dimensions of territorial capital that can be used to characterise the territorial capital of the EU regions in the 2010s. On the other hand, based on the results of the principal component analysis, I classify the EU-28 NUTS 2 regions and describe them based on the results obtained with dimension reduction.

The remainder of this paper is organised as follows. Next section presents a brief overview of the existing literature on the original (2008) and revised (2019) versions of the theoretical taxonomy of territorial capital components. Following section describes the research methods and structure of the data. Table A1 in the Appendix contains further information about the dataset and an account of the sources of the different variables collected, along with their definitions. Next section reveals the main components of territorial capital at the European level based on the results of the principal component analysis. In this section, the application of cluster analysis techniques and the main outcomes of the procedure are presented. Table A2 in the Appendix contains the ranking of clusters and subclusters along with cluster centres (mean values) based on the individual factor scores derived from dimension reduction. The study concludes by presenting some of the main findings, limitations, future research agendas, and policy implications.

Literature review: the theoretical taxonomy of territorial capital

The first ordered theoretical taxonomy of the components of territorial capital was built upon two main dimensions, 'rivalry' (public goods, private goods, and an intermediate class of club goods and impure public goods) and 'materiality' (tangible goods, intangible goods, and an intermediate class of mixed goods), providing a three-by-three matrix-like scheme that allows categorisation all potential sources of territorial capital. Beyond the four extreme classes – high and low rivalry, tangible and intangible goods (also referred as the 'traditional square') – five intermediate classes cover an innovative integration of hard and soft elements (also referred as the 'innovative cross'), which imply a capacity to convert the potential traditional resources and goods into effective actions and interactions among economic agents (Camagni 2008).

Hard elements are traditional private and public goods, which are the basis of general attractiveness, such as social overhead capital (e.g. infrastructure) and a mix of public and privately owned natural and cultural resources and goods (e.g. landscape and cultural heritage systems). Tangible goods also include territorial endowments which

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enable advantages to be taken of expansions in demand or production in the local context (e.g. private fixed capital, toll goods, externalities of a hard nature).

Regarding the *soft elements*, human, relational, and social capital are of paramount importance. The human capital class incorporates knowledge, entrepreneurial spirit, and creativity; however, the pecuniary externalities supplied by advanced services (e.g. finance and consultancy) are also significant. Regarding social capital, a formal–informal dichotomy at both the micro level, including individual relations, social networks, trust, participation, and macro level, including institutions, rules, norms, behavioural models, and values, is emphasised. Together, these assets are regarded as 'the „glue" that holds societies together' (Camagni 2008: 40.). Relational capital contains the establishment and maintenance of the right linkages among economic actors in a socio-economic context. As Benassi et al. (2021: 171.) note, soft skills have become the key element of development that are the distinctive features of every single territory; they belong to a territory's rational, cognitive, and social system, and these three dimensions together create 'the hummus in which the different development and growth paths of each territory take shape'.

According to Capello (2016), the matrix underlines the importance of the category of mixed goods (*hard + soft elements*) by representing complex territorial organisations, such as industrial districts, which are the sources of agglomeration economies. In addition, the peculiarity of the intermediate classes lies in the fact that they require new forms of governance, especially local governance based on co-operation; accordingly, private/public synergy may perform well. Moreover, one might also agree with the idea that every relationship network established among various social actors (including civil society) strengthens the overall cohesion of society (cf. Etzkowitz–Leydesdorff [1995], Carayannis et al. [2012] about the Triple, Quadruple, and Quintuple Helixes).

A revised version of this taxonomy was published after minor changes were implemented (Camagni 2019). Figure 1 presents the various categories of territorial capital. The structure of the matrix and the two main dimensions did not change; however, perhaps for a greater emphasis on the crucial elements, some of the terms were reconsidered.

For instance, in quadrant b), as collective goods are subject to congestion and free-rider effects, especially to overcrowding from an access of tourism (viz. overtourism), the cultural heritage system (e.g. the urban historical centres) requires a more careful, far-sighted, and sustainable use (Camagni 2019). In line with this, as the author notes, fruitful local synergies might occur if a strong sense of belonging and loyalty coupled with a far-sighted business perspective matches the social stigmatisation of opportunistic behaviour. This is also known as the *milieu* effect that may be regarded as the true territorial capital, allowing long-term efficiency for other components as well, such as the elements of quadrant e) (e.g. collective actions, agreements).

In quadrants d) and e), *civicness* (civic and social virtues) and *associationism* (relational attitudes and co-operation capacities), namely, intangible assets of relational capital and social capital, which are embedded in the local society and impossible to transfer elsewhere (Capello 2016), are emphasised more distinctly. When appropriately combined, these elements can be regarded as decisive factors in determining the success of places (e.g. cities, regions) and of nations (Camagni 2017).

Figure 1

A theoretical taxonomy of the components of territorial capital

High rivalry (private goods)	Private fixed capital stock Pecuniary externalities (hard) Toll goods (excludability) c)	Relational private know-how in: – firms' external linkages – transfer of R&D results University spin-offs i)	Human capital: – entrepreneurship – creativity – private know-how Pecuniary externalities (soft) f)
(club goods) (impure public goods)	Proprietary networks Collective goods: – landscape (rural/urban) – cultural heritage (private 'ensembles' historical centres) b)	Cooperation networks: – strategic alliances in R&D and knowledge – p/p partnerships in large development schemes Quality of institutions governance on land and cultural resources h)	Relational capital (associationism): – cooperation capability – collective action capability – collective competencies e)
(public goods) **Low rivalry**	Resources: – natural – cultural (punctual) Social overhead capital: – infrastructure a)	Agencies for R&D transfer/transcoding Local receptivity-enhancing conditions Accessibility/ connectivity Agglomeration and district economies g)	Social capital (civicness): – institutions – behavioural models, values – trust, reciprocity – reputation d)
	Tangible goods (hard)	**Mixed goods** (hard + soft)	**Intangible goods** (soft)
	Materiality		

(left vertical label: Rivalry)

Note: R&D: research and development; p/p: public–private.
Source: Camagni (2019).

The importance of reputation and reciprocity was emphasised in the revised version of the taxonomy, mainly due to Elinor Ostrom's contribution to the analysis of economic governance. Regarding the concept of territorial capital, the relational approach and the success elements of governance ('good governance') seem to be more crucial than before. Instead of pure competitive rationality, a new (second) generation of rational choice models has been developed, including trust, reciprocity,

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and reputation (Camagni 2019). In addition, in quadrant h), the quality of the government is explicitly indicated, which, together with strategic alliances for R&D and knowledge creation, serves as a key tool for fair and fast implementation of the knowledge society. Granting initiatives are also considered in this quadrant, perhaps to underline the importance of the accumulation of both tangible and intangible assets by the realisation of grant contacts.

Concerning quadrant i), renaming 'relational private services' to 'relational private know-how' in firms' external linkages and the transfer of R&D results seem to reflect interregional growth spillovers and external interdependencies with a growing awareness compared to the earlier version.

Although the theoretical taxonomy of territorial capital calls a number of structural and functional characteristics into service that generate the growth potential of cities, regions, and places, the classification system has its own weaknesses and limitations. On the one hand, the taxonomy represents an innovative step in the knowledge of conceptual dimensions of territorial capital (Benassi et al. 2021), as well as enables the identification of the different territorial capital assets expected to stimulate economic development (Fratesi–Perucca 2018). On the other hand, some items differ only in terms of the theoretical approach of their proponents (Affuso–Camagni 2010), and the classification system leaves the attribution of each component to the subjectivity of the researcher (Morretta 2021). The taxonomy serves as a conceptual guide for selecting and choosing among different proxies that measure the different components of territorial capital (Lo Cascio et al. 2013); however, the main difficulty in translating the items into empirical terms has always been the identification of appropriate metrics and proxies (Fratesi–Perucca 2018).

Accordingly, from an empirical perspective, the measurement of territorial capital ought to be based upon a precise selection of proxies with a clear explanation regarding why the selected variables are 'suitable' to measure the particular item of territorial capital. Fortunately, variables have progressively become available for different spatial scales, such as for larger territories and regions (NUTS 1, NUTS 2, and NUTS 3) of the European Union. In addition, solid proxy indicators have been increasingly offered by official and quasi-official statistical sources (Camagni 2017).

Materials and method

Owing to the multifaceted nature of territorial capital, its items and components can be described through several variables, indicators, indices, scores, and measurement units, as previous studies have shown (e.g. Affuso–Camagni 2010, Brasili et al. 2012, Camagni–Capello 2013, Lo Cascio et al. 2013, Perucca 2014, Martinoia–Pompili 2015, Fratesi–Perucca 2018, 2019, Mazzola et al. 2018, Castelnovo et al. 2020, Benassi et al. 2021, Morretta 2021).

Although there is no universal, widely accepted, and quoted measurement system and descriptor by scholars, this has certain advantages in terms of developing measurement modes. The measurement of territorial capital is suitable for several possible versions in terms of measurement factors and techniques. According to the relevant literature, multivariate methods, such as principal component analysis (e.g. Perucca 2014, Martinoia–Pompili 2015, Benassi et al. 2021), cluster analysis (e.g. Martinoia–Pompili 2015, Fratesi–Perucca 2018, 2019, Benassi et al. 2021), and spatial econometrics (e.g. Affuso–Camagni 2010, Capello et al. 2011, Lo Cascio et al. 2013, Perucca 2014, Fratesi–Perucca 2018, 2019, Mazzola et al. 2018, Castelnovo et al. 2020) have enabled the simultaneous observation and analysis of indicators and have helped to understand the relationships and interactions between various variables and to estimate effects over time.

The initial dataset, presented Table A1 in the Appendix, is based on 19 proxy variables, which, according to my conception, follow Roberto Camagni's theoretical taxonomy of the components of territorial capital and allow one to partially capture the role played by territorial capital. The dataset was chiefly compiled from the openly available databases of Eurostat; however, other public data providers were called into service, such as the Office of National Statistics (UK) and University of Gothenburg (SE).

Below, two large groups of elements of territorial capital are presented, with particular attention paid to the empirical part of this research. Material assets are distinguished from non-material assets; the first class covers items considered as hard elements (i.e. public and private tangible goods), and the second class includes elements considered as soft and hard + soft elements (i.e. intangible and mixed goods).[1]

Following the existing literature,[2] material assets can be captured by items related to social overhead capital and resources (quadrant a), collective goods (quadrant b), and private fixed capital (quadrant c).

Regional infrastructure endowment as a key element of social overhead capital can be partially measured by road (transport) infrastructure and networks (cf. Affuso–Camagni 2010, Brasili et al. 2012, Camagni–Capello 2013, Lo Cascio et al. 2013, Perucca 2014, Mazzola et al. 2018, Castelnovo et al. 2020) on the one hand, and by telecommunications infrastructure and networks, on the other, which, surprisingly, have not been involved in the process of operationalisation of territorial capital to date. However, as Morretta et al. (2020) and Morretta (2021) point out, a region's

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[1] The operationalisation of the components of territorial capital based upon 'rivalry' (public/private axis) might also be conceivable; however, according to Morretta (2021: 106.), 'while a distinction between tangible and intangible forms of capital is feasible, it is not always possible to know ex ante whether elements of territorial capital are private or public'. Accordingly, the process of operationalisation in this paper is based upon the 'materiality' axis.

[2] In order to defend the selection of proxies, authors who used very similar or same proxies at quantitative works are referred to in subsequent paragraphs. However, this research partially breaks the conventions used in existing territorial capital investigations by calling some new proxies into service.

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hardware is also represented by the amount and amenities of communication, which facilitate productivity, growth, social cohesion, interchange, and network connections and reduce transport costs. In addition, while being considered a proxy for social overhead capital, the availability of Internet services has already been considered a proxy for private capital because of its high correlation with the stock of physical investments (Fratesi–Perucca 2018, 2019).

In addition to infrastructural endowment, the share of artificial land is essential for measuring social overhead capital. On the one hand, dense urban fabric has a major role in enhancing the profitability of local activities (Camagni 2019), and buildings are crucial to facilitate growth (Morretta 2021); on the other hand, dense artificial areas might generate problems of excessive crowding and congestion (Affuso–Camagni 2010).

In this study, social overhead capital is captured by three variables: the density of motorway infrastructure, the density of broadband Internet services, and the share of artificial land in total land use.

Territorial resources and amenities related to nature and culture can be regarded as the basis for the general attractiveness of the local territory (Camagni 2008, Martinoia–Pompili 2015, Fratesi–Perucca 2018, Mazzola et al. 2018). Environmental resources are captured by the share of cropland as the 'residence' of agricultural production, as well as the share of woodland and the share of grassland in total land use (cf. Martinoia–Pompili 2015, Benassi et al. 2021). The last two indicators might also be considered collective goods that are part of the rural landscape. Territorial resources related to culture can be measured by indices of touristic performance (Affuso–Camagni 2010, Lo Cascio et al. 2013, Perucca 2014, Martinoia–Pompili 2015, Mazzola et al. 2018); in this case, the net occupancy rate of bedrooms in hotels and similar accommodations is called into service to describe the presence of cultural resource endowment.

The last group of variables regarding the class of material assets is private fixed capital, which enables savings, investment, and the advantage of being available on demand (Camagni 2008, 2019). In the current analysis, four variables are considered when measuring private fixed capital. First, the density of broadband Internet services are considered, for the reasons described above. Second, gross fixed capital formation shows how much of the new value added in the economy is invested rather than consumed. In addition, household net disposable income is included in the set of indicators, as it enables savings beyond consumption expenditure. Net disposable income can be thought of as an outcome-oriented indicator of territorial capital utilisation on the one hand (through consumption) and a component of territorial capital itself on the other (through savings and the possibility of investment) that help to explain the patterns of regional economic growth and development. Finally, the stock of private property is captured by the number of passenger cars per 1,000 inhabitants, although this variable has not been included in previous studies.

In this study, non-material assets include elements related to human capital (quadrant f), agglomeration and district economies, connectivity (quadrant h), and governance (quadrant i).

Camagni (2008, 2019) underlines that human capital, including private know-how, creativity, and entrepreneurship, is a fundamental capital asset and competition factor available to territories that strengthens local activities and attracts foreign ones. In addition, as Affuso–Camagni (2010) note, high-level functions affect economic growth. Private know-how is measured by the share of the population aged 25 to 64 with tertiary education and the participation rate in education and training (cf. Brasili et al. 2012, Lo Cascio et al. 2013, Perucca 2014, Martinoia–Pompili 2015, Mazzola et al. 2018, Fratesi–Perucca 2019, Castelnovo et al. 2020), creativity is captured by the share of scientists and engineers in the total labour force, as well as the share of employment in high-technology sectors (cf. Camagni–Capello 2013, Martinoia–Pompili 2015).

The second group of variables, regarding the class of non-material assets, relates to agglomeration and district economies, and connectivity. According to Perucca (2014) and Fratesi–Perucca (2018, 2019), resident population density is an appropriate measure of agglomeration economies as well, mainly because it contains fundamental information for evaluating regional settlement patterns (Brasili et al. 2012).

According to Camagni (2008, 2019), connectivity is defined as a condition in which pure physical infrastructure is utilised in a targeted and purposeful way by single actors in order to collect information, organise transactions, and exchange messages. Efficient digital networks enable interchange and network connections (Morretta et al. 2020); accordingly, besides the amenities of telecommunication (e.g. broadband Internet services), the utilisation of telecommunication facilities should be also taken into account when measuring territorial capital. In this case, the variable of regular use of the Internet is called into service as an indicator to capture connectivity.

Means and modes of transport, such as air transport, facilitate and expedite the exchange of people, goods, and services (Brasili et al. 2012), and are crucial to facilitate interchange (Morretta et al. 2020), employment, and economic growth (Mazzola et al. 2018, Morretta 2021), as well as being related to proximity (Perucca 2014) and to the ease of being reached by potential users for an activity located in a certain zone (Benassi et al. 2021). In the current analysis, the second variable to capture connectivity is the air transport of passengers.

Finally, according to Morretta (2021), governance is crucial for triggering the process of endogenous development, and local governments in good condition can easily promote the business environment and facilitate the development process and accumulation of other territorial assets, such as the accumulation and effectiveness of transport infrastructure (Morretta et al. 2020). The European Quality of Government Index is used in this study to describe the quality of institutions. This variable contains sub-national standardised data based on three pillars: corruption, impartiality, and

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quality (Charron et al. 2019). The percentage of individuals who use the Internet for interaction with public authorities might mirror the new form of governance (e.g. obtaining information from government websites on interactive procedures and availability of online submission channels); accordingly, this proxy is involved in capturing governance.

The dataset considers the period 2010–2019, covered by the years of recovery of the European economy in the aftermath of the Great Recession, as well as an era of a relative boom and high growth. The geographical unit of the analysis is represented by the EU-28 NUTS 2 regions, according to NUTS version 2016. Due to the lack of available data, 270 regions from the EU-28 are involved in the current research.[3] In the case of the three information and communication technology (ICT) usage-related variables (density of broadband Internet services, share of individuals using the Internet daily, share of individuals using the Internet for interaction with public authorities), NUTS 2 level data are substituted with data on corresponding NUTS 1 levels in the case of Germany, Greece, Poland, and the United Kingdom. Concerning the European Quality of Government Index, data are only available on the NUTS 1 level in the following Member States: Belgium, Germany, Greece, Hungary, Ireland, Lithuania, Sweden, and the United Kingdom; thus, regional data are substituted with data on the corresponding NUTS 1 level. As data are partially available for some regions, missing data were filled using simple averages of the previous and subsequent available years or the natural growth rate of the variable.

Empirical results: territorial capital at the European level

Application of principal component analysis (PCA)

The PCA consists of two phases. In the first phase, for material and non-material assets, different PCAs are applied to deliver clearer results, that is, to be able to label components easily. In the second phase, variables that drop out from the two initial models are subject to the dimension reduction process to preserve as many variables as possible, while creating a third meaningful component for further analysis. As a result, 16 of the 19 original variables remained effective. Table 1 summarises the results of the two phases, along with the three components, the corresponding variables, and the respective component weights.

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[3] Åland (FI), Canarias (ES), Ciudad Autónoma de Ceuta (ES), Ciudad Autónoma de Melilla (ES), Guadeloupe (FR), Martinique (FR), Guyane (FR), La Réunion (FR), Mayotte (FR), Região Autónoma de Açores (PT) and Região Autónoma de Madeira (PT) are excluded from the current analysis.

Table 1

Results of the PCA – Component matrixes

	Name of components and corresponding variables	Weight
PHASE I	*Component I: Material resource endowment: social overhead capital – collective goods relation*	
	Occupancy rate of bedrooms in hotels and similar accommodation per 100 inhabitants	0.804
	Share of artificial land in total land area	0.773
	Density of broadband Internet services	0.740
	Density of motorway infrastructure	0.712
	Share of woodland in total land area	–0.572
	KMO measure of sampling adequacy: 0.759. Barlett's test of sphericity: χ^2=350.468 df=10 p=0.000. Measures of sampling adequacy (MSA) values between 0.736 and 0.822. Total variance explained: 52.521%	
	Component II: Non-material resource endowment: connectivity – governance – human capital synergy	
	Share of individuals using the Internet daily	0.918
	European Quality of Government Index	0.869
	Participation rate in education and training	0.865
	Share of individuals using the Internet for interaction with public authorities	0.863
	Share of scientists and engineers in total labour force	0.804
	Share of population with tertiary education	0.797
	KMO measure of sampling adequacy: 0.825. Barlett's test of sphericity: χ^2=1468.445 df=15 p=0.000. MSA values between 0.717 and 0.928. Total variance explained: 72.877%	
PHASE II	*Component III: Material–non-material asset relations: private fixed capital – connectivity – human capital synergy*	
	Gross fixed capital formation	0.787
	Share of employment in high-technology sectors	0.759
	Air transport of passengers	0.751
	Net disposable income of households per inhabitant	0.631
	Population density	0.529
	KMO measure of sampling adequacy: 0.657. Barlett's test of sphericity: χ^2=361.625 df=10 p=0.000. MSA values between 0.607 and 0.782. Total variance explained: 48.739%	

Note: Only factor weights above 0.500 are considered in this analysis.

The Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy shows that the first model is middling, the second one is meritorious, and the third one is mediocre, confirming their fitness. At the same time, Bartlett's tests of sphericity are proven significant, further underscoring the goodness of our models. All measures of sampling adequacy (MSA) in the anti-image correlation matrix are above 0.500, fitting the rule-of-thumb, which suggests that the calculated components explain a large proportion of the variance.

The first important result is that each component allows us to obtain a deeper insight into the territorial capital of the EU-28 NUTS 2 regions in the 2010s, and each

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component produces a rather different picture. It can be concluded that both material and non-material factors and their interrelations play a key role in the formation of territorial capital at the European level. The maps (Figures A1–A3) in the Appendix shown the regional distribution of the factor scores.

Compressing five indicators, component I includes information about the 'material resource endowment'. This dimension is strongly determined by the corresponding variables related to social overhead capital and collective goods. Figure A1 in the Appendix shows that the capital regions, metropolitan areas, and larger urban zones have the highest scores. In addition, several regions of the Benelux states and the United Kingdom (e.g. English Midlands), as well as regions of Nordrhein-Westfalen (DE), demonstrate very high values. This component indicates that the material resource endowment is rather limited in the sparsely populated peripheral areas of Scandinavia as well as in the less developed regions of the EU (regions of Eastern Europe and part of the Mediterranean). The lowest scores, limited material resource endowment, can be detected in the easternmost regions of the EU; in the Baltic states and Northern Poland, in Czechia and Slovakia, as well as in Romania, Bulgaria, and Greece, large homogenous areas with a cross-border character can be mapped.

Component II, termed as 'non-material resource endowment', integrates six variables; this component is chiefly determined by proxies that are in relation with governance, connectivity, and human capital. Figure A2 in the Appendix shows that capital regions are generally equipped with more non-material resources than the countryside. Regions of the Scandinavian countries register the highest scores; however, several Dutch and British regions – primarily regions in the south of England – can be placed just behind the cutting edge. The regions in Southern Italy, Bulgaria, Croatia, Greece, and Romania show the scarcest capacity in terms of non-material resource endowment; like in the case of the previous component, large homogenous areas can be mapped with the exception of the capital regions, which show better, but not outstanding performance in their country. It can be also concluded that a sharp west–east divide is apparent with regards to the first two dimensions of territorial capital.

Component III is strongly determined by corresponding variables that are in relation with private fixed capital, connectivity, and human capital; accordingly, high scores of some of the material resources can match high scores of some of the non-material resources. Thus, this dimension reveals information about the 'material–non-material asset relations'. As Figure A3 in the Appendix presents, metropolitan areas, 'mega' regions, and major capitals register the highest scores. Relatively high scores are reported from the countryside in the Western European countries; however, adjacent regions in the countryside show great diversity. As the case of regions in the easternmost part of the EU suggest, relatively low level of tangible capital pair with relatively low level of intangible capital.

Application of two-step and hierarchical cluster analyses

In the course of the two-step procedure, based on the factor scores of the three components, cluster quality was tested with different distance measures (Euclidean and log-likelihood) and potential cluster number solutions (from two to eight). Of the possible solutions, according to the silhouette measure of cohesion and separation, a three-cluster grouping with log-likelihood as a distance measure provides the best cluster quality; the average silhouette width is 0.6, which indicates that a reasonable structure has been found.[4] Regarding the importance of predictors in cluster building, the results show that all components are remarkable in the creation of clusters (component I: 1.00, component II: 0.99, component III: 0.89). The ratio of cluster sizes is 4.87. The size of the smallest cluster is 31 (11.5 percent of regions), the size of the middle cluster is 88 (32.6 percent of regions), and the size of the largest cluster is 151 (55.9 percent of regions).

Hierarchical cluster analysis was selected because of its expressive demonstration of how distinctly different subgroups, hereinafter referred to as subclusters, emerge. This procedure provides deeper insight into understanding regional performance without setting artificial thresholds or group numbers (such as in the case of the K-means cluster method). In this analysis, the cluster method and interval scale of measurement to determine the distance between regions are Ward's minimum variance criterion with squared Euclidean distance, as this procedure minimises the total within-cluster variance. The algorithm separates further subclusters within each cluster derived by the two-step procedure, which represents the existence of different levels of territorial capital in the European Union during the 2010s. The model shows that the EU-28 NUTS 2 regions fall into 13 subclusters; the smallest and middle clusters can be divided into four additional subclusters, whereas the largest cluster consists of five subclusters.

Figure A4 in the Appendix presents a map of the diversity of European regions based on the three components (dimensions) of territorial capital, and Table A2 in the Appendix summarises subcluster membership in the fourth step along with the value of subcluster centres,[5] while also presenting the ranking of subclusters based on the group centres in all three dimensions.

An important finding of the current research is that the territorial capital shows great diversity across the EU-28 during the 2010s, which can be verified through the characteristics of clusters. The previous analysis helps reveal the main features behind this classification, indicating that Cluster 1 contains the leading regions in terms of all three dimensions of territorial capital. Besides Inner-London (UK) and the Paris (FR) metropolitan area as the main hubs of territorial capital (subcluster 1.1), several

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[4] The automatic cluster number determinations, based on Akaike's Information Criterion (AIC) and Schwarz's Bayesian Criterion (BIC) as clustering criteria, also lead to the three-cluster grouping solution (average silhouette width=0.6).

[5] The standard deviation values show that subclusters are homogenous.

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European regions have the potential to maximise their territorial capital, as they are relatively highly endowed with material and non-material resources. One might find minor diversities within this cluster; while the Copenhagen (DK), Helsinki (FI) and Stockholm (SE) capital regions as well as London's (UK) larger urban zone have outstanding capacities in non-material assets (subcluster 1.2), the Amsterdam (NL), Berlin (DE), Brussels (BE), Budapest (HU), Prague (CZ) and Vienna (AT) capital regions along with the agglomeration of Birmingham (UK), Bremen (DE), Düsseldorf (DE), Hamburg (DE), Manchester (UK) and Utrecht (NL) have exceptional potential in material resources (subcluster 1.3). The fourth possible subcluster comprises regions with significant capacities in the material–non-material asset relations, including the Dublin (IE), Frankfurt (DE), Madrid (ES), Milan (IT) and Munich (DE) metropolitan regions (subcluster 1.4).

The common feature of Cluster 2 is a moderate level of territorial capital. Subcluster 2.1 and 2.2 build on regions that have considerable territorial capacities, either in the form of material assets (primarily the British and Dutch regions) or non-material assets (mostly Scandinavian regions), while being well-endowed with the other type of asset at the same time. Two additional groups of regions show average but evolving territorial capacity. The capital regions of Central and Southern Europe, such as Athens (EL), Brandenburg (DE), Bratislava (SK), Bucharest (RO), Pest (HU), Rome (IT), and Warsaw (PL) – along with several regions of the 'Sunbelt' – or the so-called Latin Arc (cf. Affuso–Camagni 2010, Affuso–Fratesi 2011) – show developing capacities in the material and non-material asset relations (subcluster 2.3). Regions in the northern, central, and southern parts of Germany show similarities with regions in the north of France and the UK; they have developing capacities in material resource endowment (subcluster 2.4). Regions of Austria, along with a great number of regions in the central parts of France, east of Germany, and north of Spain, show similarities in demonstrating the lack of capacity in terms of territorial capital (subcluster 2.5).

Cluster 3 includes regions which show poor capacities in terms of territorial capital, perhaps because they fail to mobilise their territorial endowments. Members of this cluster also showed minor diversity. On the one hand, several regions, especially Italy, are scarcely endowed with non-material assets (subcluster 3.1); on the other hand, a large number of regions, mainly Hungary and Poland, have weak capacities in the material–non-material asset relations (subcluster 3.2). Regions with weak capacities in material assets can be found not only in Central and Eastern Europe, but also in Southern Europe (e.g. Portugal, central regions of Spain) (subcluster 3.3). The absolutely lagging-behind regions with extremely scarce territorial capital endowment can be found in the east of Poland and south of Italy, and large homogenous spaces can be detected in the Bulgarian, Greek, and Romanian countryside (subcluster 3.4).

Conclusions

Territorial capital can be considered an important driver and catalyst of regional growth and development, and is a useful concept that encompasses a wide variety of territorial assets ranging from tangible assets and goods to intangible assets and goods. Given these premises, the concept of territorial capital requires closer inspection and empirical research.

A fruitful use of the measurement of territorial capital is the grouping and ranking of European regions, in line with Roberto Camagni's theoretical taxonomy, and multivariate statistical methods served as a good basis for this empirical investigation. Although it was necessary to include proxy variables during the operationalisation, the results confirm the usability of the theoretical taxonomy of territorial capital and enable a more subtle mapping and ranking of the EU regions in the principal dimensions of territorial capital in the 2010s.

The main novelty of this study is the information and analysis that provides, to the best of my knowledge, one of the most complete, spatially detailed, and up-to-date depiction of territorial capital at the European level in recent years. Nineteen indicators were collected, and 16 of them were merged into three components. It has been shown that material resource endowment (component I) is determined by elements related to social overhead capital and collective goods, and non-material resource endowment (component II) covers items related to connectivity, governance, and human capital. In addition, the relationship between intangible and intangible resource endowments (component III) has proven crucial, integrating proxies that explain private fixed capital, connectivity, and human capital.

The cluster analyses resulted in three clusters as well as a 13 subcluster solution. The empirical results regarding the status of territorial capital of the EU-28 NUTS 2 regions over the 2010s testify to the role of material and non-material components as well as their interrelation in the formation of territorial capital at the European level. Another important finding is that territorial capital presents a diverse picture within the EU. The study has managed to represent and confirm the large heterogeneity across the European space, for instance, according to the degree of urbanisation and the relative development of regions. Based on my results, a sharp divide between the Western and Eastern European regions in the EU is obvious, not only in terms of material and non-material resource endowment, but also in terms of the material–non-material assets relationship.

This study has some limitations that require further research. A key limitation is that several components of territorial capital remain 'hidden', as regional databases do not provide data that can be related to all components of territorial capital according to the theoretical taxonomy. Camagni (2017) notes that it is difficult to find data for cities and functional urban areas; accordingly, the entire measurement system can be amended and improved. Greater efforts in terms of data collection should be

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made to test other elements of territorial capital. Further research agenda also includes several other activities, such as improving methodology using combined and mixed methods. In addition to survey research, fieldwork and site visits might be options for exploring social capital, relational capital, and other forms of intangible capital in different case studies.

These findings are of strong practical relevance, as they have important implications for new spatial development policies in line with place-based approaches (Barca 2009, 2011), especially to take advantage of territorial capital assets and establish specific development strategies for each region that seek to make the most of its assets (Camagni–Capello 2013). However, soft elements of territorial capital cannot support 'lagging-behind' regions on their own; boosting regional development depends on conjunctions between the more traditional elements and the soft ones (Camagni 2017). In other words, the greatest efficiency in the exploitation of territorial capital resides in the integration of tangible and intangible elements, which reinforce each other (Capello 2016). This approach may widen the vision of territorial development policies and make it possible to understand the uniqueness of places. Adequate knowledge of territorial capital helps decision-makers identify further actions for improvement. The concept can be used as a reference point and a major source to guide further research agendas and policy making by monitoring and comparing the performance of different regions, including the socio-economic and spatial impacts of the COVID-19 pandemic.

Acknowledgements

Appendix

<div align="right">Table A1</div>

<div align="center">

The initial set of indicators

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Name of variable	Period, time intervals	Definition of variable	Variable's position in the taxonomy of territorial capital
Share of artificial land in total land area, %	2012, 2015, 2018	The indicator measures the share of built-up area and artificial non-built up area in total land cover.	a) social overhead capital (infrastructure)
Density of broadband Internet services, %	2010–2019	The indicator measures the share of private households with broadband access.	a) social overhead capital (infrastructure) & c) private fixed capital
Density of motorway infrastructure, km/km²	2010–2019	The indicator measures the length of road specially designed and built for motor traffic per thousand square kilometres.	a) social overhead capital (infrastructure)
Share of cropland in total land area, %	2012, 2015, 2018	The indicator measures the share of land use for permanent and non-permanent industrial crops, vegetables and plants in total land cover.	a) resources (natural)
Share of woodland in total land area, %	2012, 2015, 2018	The indicator measures the share of land use for broadleaved and coniferous woodland in total land cover.	a) resources (natural) & b) collective goods (landscape)
Share of grassland in total land area, %	2012, 2015, 2018	The indicator measures the share of grassland with and without tree or shrub cover in total land cover.	a) resources (natural) & b) collective goods (landscape)
Occupancy rate of bedrooms in hotels and similar accommodation per 100 inhabitants, %	2010–2019	The rate is obtained by dividing the sum of the bedrooms in use by the sum of bedrooms available. The result is multiplied by 100.	a) resources (cultural)
Gross fixed capital formation, million EUR	2010–2019	Gross fixed capital formation (GFCF) measures the value of acquisitions of new or existing fixed assets by the business sector, governments and pure households less disposals of fixed assets, a component of the expenditure on gross domestic product (GDP) about how much of the new value added in the economy is invested rather than consumed.	c) private fixed capital
Net disposable income of households per inhabitant, EUR	2010–2019	Households' net disposable income is the money that is available to households to invest, save, or spend on necessities and nonessential items after deducting income taxes.	c) private fixed capital

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Name of variable	Period, time intervals	Definition of variable	Variable's position in the taxonomy of territorial capital
Stock of passenger cars per 1.000 inhabitants, pcs	2010–2019	The rate is obtained by dividing the stock of passenger cars by the total number of inhabitants. The result is multiplied by 1.000.	c) private fixed capital
Share of population with tertiary education, %	2010–2019	The indicator measures the share of population aged 25 to 64 with tertiary education (levels 5–8 according to ISCED 11).	f) human capital (private know-how)
Participation rate in education and training, %	2010–2019	The indicator measures the share of population aged 25 to 64 participating in education and training.	f) human capital (private know-how)
Share of scientists and engineers in total labour force, %	2010–2019	The indicator measures the percentage of scientists and engineers in total population in the labour force.	f) human capital (creativity)
Share of employment in high-technology sectors (%)	2010–2019	The indicator measures the percentage of employment in high-technology manufacturing and knowledge-intensive high-technology services (HTC according to NACE Rev. 2. economic activities) of total employment.	f) human capital (creativity)
Population density (person/km²)	2010–2019	The rate is obtained by dividing the number of population by total land area.	g) agglomeration and district economies
Share of individuals using the Internet daily (%)	2011–2019	The indicator measures the percentage of individuals who regularly use the Internet.	g) connectivity
Air transport of passengers (thousand persons)	2010–2019	The indicator measures all revenue and non-revenue passengers whose journey begins or terminates at the reporting airport. Transfer passengers joining or leaving the flight at the reporting airport are also taken into account.	g) connectivity
European Quality of Government Index (score)	2010, 2013, 2017	The index is based on a large citizen survey where respondents were asked about perceptions and experiences with public sector corruption, along with the extent to which citizens believe various public sector services are impartially allocated and of good quality. The sub-national z-score standardized data is based on three pillars (corruption, impartiality, quality) and centred around the World Government Index (WGI) country-level scores.	h) governance
Share of individuals using the Internet for interaction with public authorities (%)	2011–2019	The indicator measures the percentage of individuals who used the Internet for interaction with public authorities.	h) governance

The composition of clusters and subclusters: cluster centres and the ranking of clusters based on factor scores

Clusters	Subclusters	The composition of clusters and subclusters	I. Material resource endowment: social overhead capital – collective goods relation		II. Non-material resource endowment: connectivity – governance – human capital synergy		III. Material–non-material asset relations: private fixed capital – connectivity – human capital synergy	
			Average (Std. dev.)	Rank	Average (Std. dev.)	Rank	Average (Std. dev.)	Rank
1.	1.1	*Regions with extremely high territorial capital endowment (4 regions):* Inner London–West (UK) – Outer London–West and North West (UK) – Inner London–East (UK) – Île-de-France (FR)	2.46 (0.92)	1.	1.52 (0.38)	2.	4.45 (1.66)	1.
	1.2	*Regions relatively highly endowed with territorial capital, significant capacities in non-material assets (5 regions):* Berkshire, Buckinghamshire and Oxfordshire (UK) – Surrey, East and West Sussex (UK) – Helsinki-Uusimaa (FI) – Stockholm (SE) – Hovedstaden (DK)	0.78 (0.47)	4.	2.09 (0.55)	1.	1.88 (0.23)	3.
	1.3	*Regions relatively highly endowed with territorial capital, significant capacities in material assets (17 regions):* Zuid-Holland (NL) – Outer London–East and North East (UK) – Outer London–South (UK) – Utrecht (NL) – Noord-Brabant (NL) – West Midlands (UK) – Prov. Vlaams-Brabant (BE) – Greater Manchester (UK) – Praha (CZ) – Düsseldorf (DE) – Bremen (DE) – Budapest (HU) – Région de Bruxelles-Capitale/Brussels Hoofstedelijk Gewest (BE) – Hamburg (DE) – Berlin (DE) – Wien (AT) – Noord-Holland (NL)	2.16 (0.51)	2.	0.90 (0.48)	5.	1.16 (0.61)	4.

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Clusters	Subclusters	The composition of clusters and subclusters	I. Material resource endowment: social overhead capital – collective goods relation		II. Non-material resource endowment: connectivity – governance – human capital synergy		III. Material–non-material asset relations: private fixed capital – connectivity – human capital synergy	
			Average (Std. dev.)	Rank	Average (Std. dev.)	Rank	Average (Std. dev.)	Rank
1.	1.4	*Regions relatively highly endowed with territorial capital, significant capacities in material–non-material asset relations (5 regions):* Oberbayern (DE) – Darmstadt (DE) – Eastern and Midlands (IE) – Comunidad de Madrid (ES) – Lombardia (IT)	0.69 (0.56)	5.	0.36 (0.71)	6.	2.66 (0.40)	2.
2.	2.1	*Regions with considerable capacities in material assets and well-endowed with non-material assets (30 regions):* Prov. Oost-Vlaanderen (BE) – Merseyside (UK) – Limburg (NL) – South Yorkshire (UK) – Drenthe (NL) – Zeeland (NL) – Friesland (NL) – Cornwall and Isles of Scilly (UK) – Cumbria (UK) – Gelderland (NL) – Kent (UK) – Overijssel (NL) – Flevoland (NL) – Groningen (NL) – West Yorkshire (UK) – Shropshire and Staffordshire (UK) – Derbyshire and Nottinghamshire (UK) – Hereford-shire, Worcestershire and Warwick-shire (UK) – North Yorkshire (UK) – Dorset and Somerset (UK) – Prov. Antwerpen (BE) – Essex (UK) – Köln (DE) – Cheshire (UK) – East Anglia (UK) – Eastern Scotland (UK) – Hampshire and Isle of Wight (UK) – Gloucestershire, Wiltshire and Bristol/Bath area (UK) – Prov. Brabant wallon (BE) – Bedfordshire and Hertfordshire (UK)	1.00 (0.28)	3.	0.91 (0.26)	4.	0.13 (0.48)	6.

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Clusters	Subclusters	The composition of clusters and subclusters	I. Material resource endowment: social overhead capital – collective goods relation		II. Non-material resource endowment: connectivity – governance – human capital synergy		III. Material–non-material asset relations: private fixed capital – connectivity – human capital synergy	
			Average (Std. dev.)	Rank	Average (Std. dev.)	Rank	Average (Std. dev.)	Rank
2	2.2	*Regions with considerable capacities in non-material assets and moderately endowed with material assets (21 regions):* Norra Mellansverige (SE) – Mellersta Norrland (SE) – Småland med öarna (SE) – Länsi-Suomi (FI) – Övre Norrland (SE) – Etelä-Suomi (FI) – Pohjois- ja Itä-Suomi (FI) – Sydsverige (SE) – Västsverige (SE) – Midtjylland (DK) – Östra Mellansverige (SE) – Leicestershire, Rutland and Northamptonshire (UK) – West Central Scotland (UK) – Luxembourg (LU) – Midi-Pyrénées (FR) – Syddanmark (DK) – Nordjylland (DK) – Sjælland (DK) – Devon (UK) – East Wales (UK) – North Eastern Scotland (UK)	–0.21 (0.52)	8.	1.37 (0.35)	3.	0.05 (0.28)	7.
	2.3	*Regions with average territorial capital endowment, developing capacities in material–non-material asset relations (17 regions):* Veneto (IT) – Emilia-Romagna (IT) – București-Ilfov (RO) – Brandenburg (DE) – Bratislavský kraj (SK) – Comunidad Valenciana (ES) – Illes Balears (ES) – Attiki (EL) – Andalucía (ES) – Pest (HU) – Stuttgart (DE) – Southern (IE) – Provence-Alpes-Côte d'Azur (FR) – Warszawski stołeczny (PL) – Rhône-Alpes (FR) – Catalunia (ES) – Lazio (IT)	0.06 (0.28)	7.	–0.22 (0.56)	9.	0.79 (0.60)	5.

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Clusters	Subclusters	The composition of clusters and subclusters	I. Material resource endowment: social overhead capital – collective goods relation		II. Non-material resource endowment: connectivity – governance – human capital synergy		III. Material–non-material asset relations: private fixed capital – connectivity – human capital synergy	
			Average (Std. dev.)	Rank	Average (Std. dev.)	Rank	Average (Std. dev.)	Rank
2	2.4	*Regions with average territorial capital endowment, developing capacities in material assets (41 regions):* Prov. Hainaut (BE) – Malta (MT) – Arnsberg (DE) – Schleswig-Holstein (DE) – Nord-Pas-de-Calais (FR) – Münster (DE) – Saarland (DE) – Prov. West-Vlaanderen (BE) – Tübingen (DE) – Mittelfranken (DE) – Freiburg (DE) – Karlsruhe (DE) – Área Metropolitana de Lisboa (PT) – Oberpfalz (DE) – Dresden (DE) – Gießen (DE) – Braunschweig (DE) – Unterfranken (DE) – Schwaben (DE) – Hannover (DE) – Rheinhessen-Pfalz (DE) – Alsace (FR) – Pays-de-la-Loire (FR) – País Vasco (ES) – Lüneburg (DE) – Haute-Normandie (FR) – Kassel (DE) – Niederbayern (DE) – Thüringen (DE) – Prov. Limburg (BE) – Prov. Liège (BE) – Detmold (DE) – Leipzig (DE) – Weser-Ems (DE) – Lincolnshire (UK) – West Wales and The Valleys (UK) – Highlands and Islands (UK) – Southern Scotland (UK) – Lancashire (UK) – East Yorkshire and Northern Lincolnshire (UK) – Northern Ireland (UK)	0.40 (0.28)	6.	0.25 (0.24)	7.	0.02 (0.29)	8.

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Clusters	Subclusters	The composition of clusters and subclusters	I. Material resource endowment: social overhead capital – collective goods relation		II. Non-material resource endowment: connectivity – governance – human capital synergy		III. Material–non-material asset relations: private fixed capital – connectivity – human capital synergy	
			Average (Std. dev.)	Rank	Average (Std. dev.)	Rank	Average (Std. dev.)	Rank
2	2.5	*Regions lacking capacity in terms of territorial capital (42 regions)*: Basse-Normandie (FR) – Poitou-Charentes (FR) – Oberfranken (DE) – Vorarlberg (AT) – Trier (DE) – Tees Valley and Durham (UK) – Picardie (FR) – Kýpros (CY) – Mecklenburg-Vorpommern (DE) – Sachsen-Anhalt (DE) – Chemnitz (DE) – Cantabria (ES) – Champagne-Ardenne (FR) – La Rioja (ES) – Región de Murcia (ES) – Koblenz (DE) – Centre–Val de Loire (FR) – Languedoc-Roussillon (FR) – Salzburg (AT) – Northern and Western (IE) – Tirol (AT) – Bretagne (FR) – Northumberland and Tyne and Wear (UK) – Aquitaine (FR) – Kärnten (AT) – Steiermark (AT) – Niederösterreich (AT) – Franche-Comté (FR) – Zahodna Slovenija (SI) – Oberösterreich (AT) – Bourgogne (FR) – Lorraine (FR) – Prov. Namur (BE) – Auvergne (FR) – Comunidad Foral de Navarra (ES) – Prov. Luxembourg (BE) – Aragón (ES) – Limousin (FR) – Principado de Asturias (ES) – Sostinès regionas (LT) – Burgenland (AT) – Eesti (EE)	–0.28 (0.27)	9.	0.11 (0.21)	8.	–0.26 (0.25)	10.

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Clusters	Subclusters	The composition of clusters and subclusters	I. Material resource endowment: social overhead capital – collective goods relation		II. Non-material resource endowment: connectivity – governance – human capital synergy		III. Material–non-material asset relations: private fixed capital – connectivity – human capital synergy	
			Average (Std. dev.)	Rank	Average (Std. dev.)	Rank	Average (Std. dev.)	Rank
3	3.1	*Regions relatively scarcely endowed with territorial capital, very weak capacities in non-material assets (11 regions):* Kontinentalna Hrvatska (HR) – Liguria (IT) – Piemonte (IT) – Toscana (IT) – Abruzzo (IT) – Sardagena (IT) – Marche (IT) – Campania (IT) – Sicilia (IT) – Puglia (IT) – Vest (RO)	–0.72 (0.14)	11.	–1.38 (0.35)	12.	–0.19 (0.31)	9.
	3.2	*Regions relatively scarcely endowed with territorial capital, very weak capacities in the material–non-material asset relations (22 regions):* Mazowiecki regionalny (PL) – Algarve (PT) – Valle d'Aosta/Vallée d'Aoste (IT) – Małopolskie (PL) – Śląskie (PL) – Közép-Dunántúl (HU) – Łódzkie (PL) – Nyugat-Dunántúl (HU) – Norte (PT) – Provinzia Autonoma di Bolzano/Bozen (IT) – Kriti (EL) – Jadranska Hrvatska (HR) – Sever-západ (CZ) – Notio Aigaio (EL) – Dél-Dunántúl (HU) – Wielkopolskie (PL) – Észak-Alföld (HU) – Dél-Alföld (HU) – Zachodniopomorskie (PL) – Kujawsko-Pomorskie (PL) – Opolskie (PL) – Świętokrzyskie (PL)	–0.60 (0.19)	10.	–1.00 (0.20)	11.	–0.84 (0.21)	12.

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Clusters	Subclusters	The composition of clusters and subclusters	I. Material resource endowment: social overhead capital – collective goods relation		II. Non-material resource endowment: connectivity – governance – human capital synergy		III. Material–non-material asset relations: private fixed capital – connectivity – human capital synergy	
			Average (Std. dev.)	Rank	Average (Std. dev.)	Rank	Average (Std. dev.)	Rank
3	3.3	*Regions relatively scarcely endowed with territorial capital, very weak capacities in material assets (27 regions):* Jihozápad (CZ) – Moravskoslezsko (CZ) – Severovýchod (CZ) – Centro (PT) – Extremadura (ES) – Vidurio ir vakarų Lietuvos regionas (LT) – Latvija (LV) – Alentejo (PT) – Východné Slovensko (SK) – Stredné Slovensko (SK) – Észak-Magyar-ország (HU) – Západné Slovensko (SK) – Střední Morava (CZ) – Kentriki Makedonia (EL) – Umbria (IT) – Yugozapaden (BG) – Dolnoś-ląskie (PL) – Pomors-kie (PL) – Jiho-východ (CZ) – Provincia Autonoma di Trento (IT) – Střední Čechy (CZ) – Friuli-Venezia Giulia (IT) – Galicia (ES) – Castilla y León (ES) – Corse (FR) – Vzhodna Slove-nija (SI) – Castilla-la Mancha (ES)	–0.99 (0.21)	12.	–0.71 (0.25)	10.	–0.60 (0.22)	11.
	3.4	*Regions with extremely scarce territorial capital endowments (28 regions):* Severoiztochen (BG) – Ionia Nisia (EL) – Yugoiz-tochen (BG) – Nord-Vest (RO) – Nord-Est (RO) – Sud-Muntenia (RO) – Sud-Est (RO) – Sud-Vest Oltenia (RO) – Dytiki Makedonia (EL) – Ipe-iros (EL) – Severen tsent-ralen (BG) – Yuzhen tsentralen (BG) – Sterea Ellada (EL) – Centru (RO) – Severozapaden (RO) – Warmińsko-Mazurskie (PL) – Podlaskie (PL) – Lubelskie (PL) – Lubuskie (PL) – Podkarpackie (PL) – Voreio Aigaio (EL) – Anatoliki Make-donia, Thraki (EL) – Thessalia (EL) – Dytiki Ellada (EL) – Peloponnisos (EL) – Molise (IT) – Basilicata (IT) – Calabria (IT)	–1.34 (0.34)	13.	–1.59 (0.37)	13.	–1.13 (0.14)	13.

Notes: Std. dev.: standard deviation. Composition of subclusters in the fourth step according to the rescaled distance cluster combination. Regions are listed according to proximity schedule.
Source: Own elaboration.

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Figure A1

The classification of EU-28 NUTS 2 regions based on the 'Material resource endowment' component

Legend:
- (–1.9765)–(–1.0570)
- (–1.9569)–(–0.7654)
- (–0.7653)–(–0.4674)
- (–0.4673)–(–0.0902)
- (–0.0901)– 0.2101
- 0.2102 – 0.5183
- 0.5184 – 1.1233
- 1.1234 – 3.2684
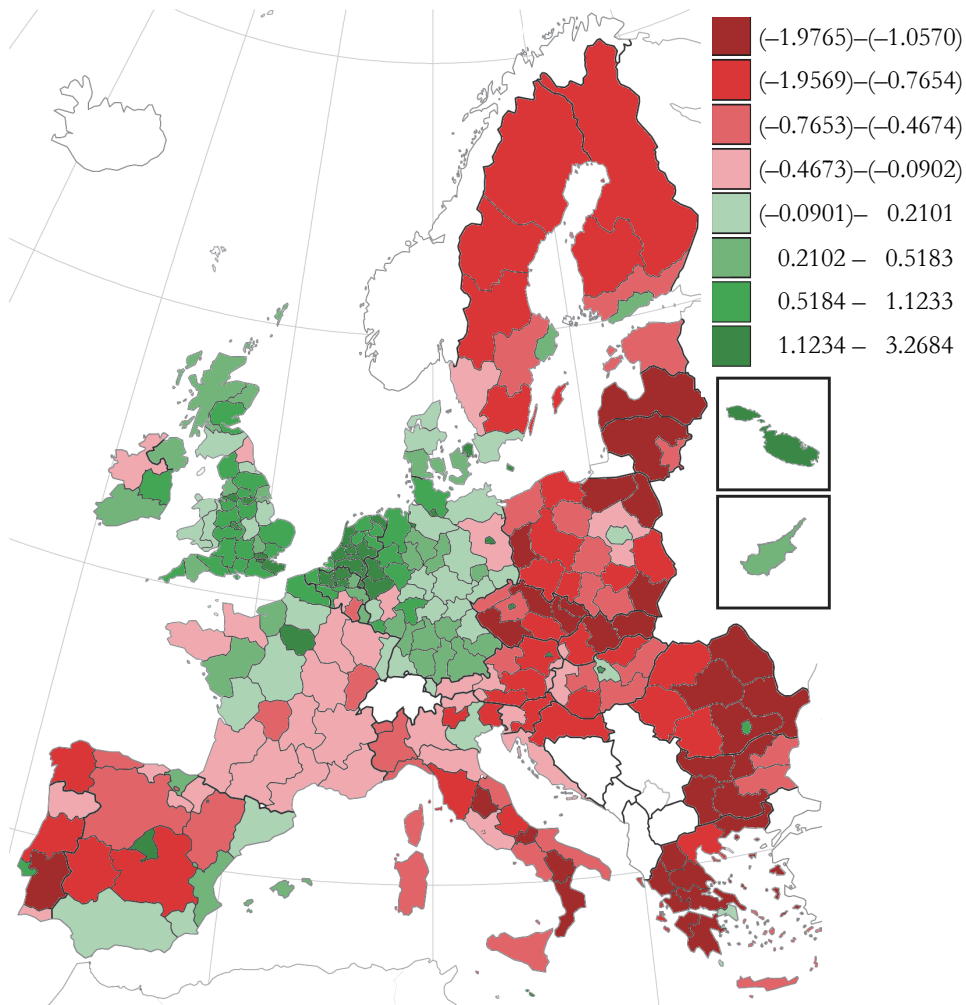
The classification of EU-28 NUTS 2 regions based on the 'Non-material resource endowment' component

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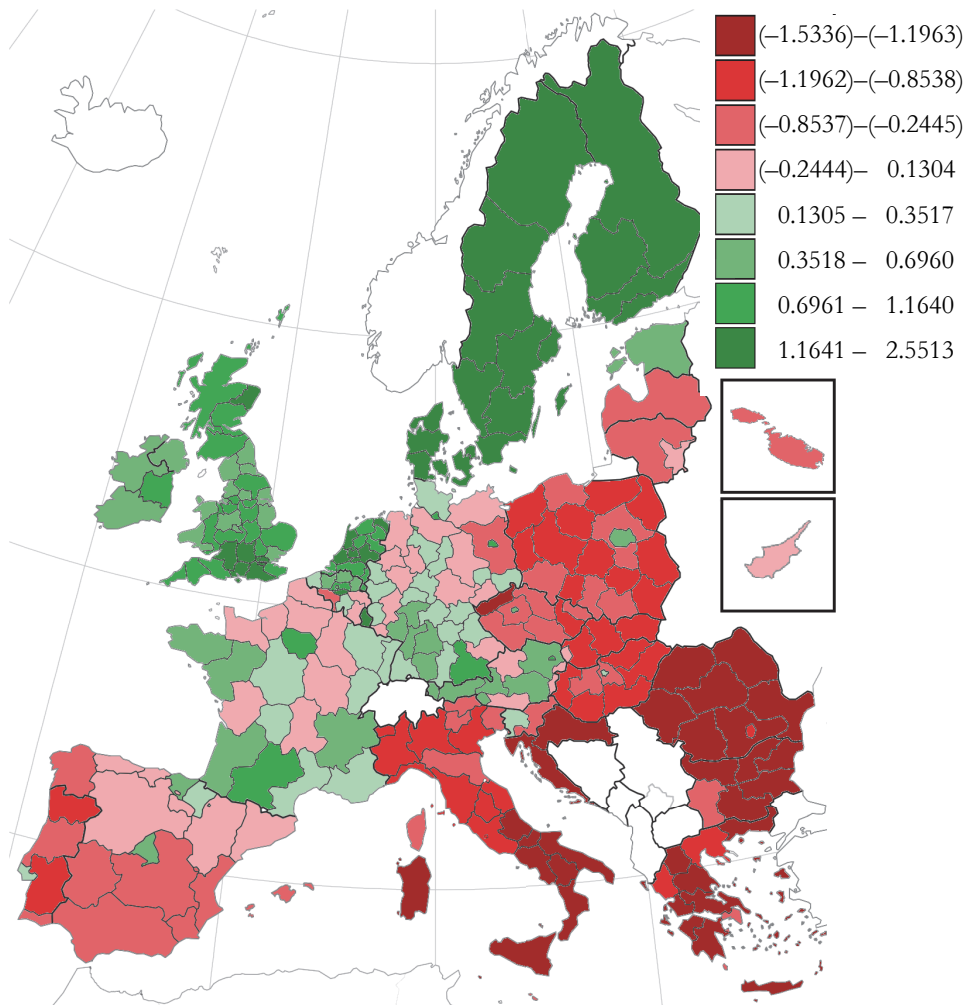
Figure A3

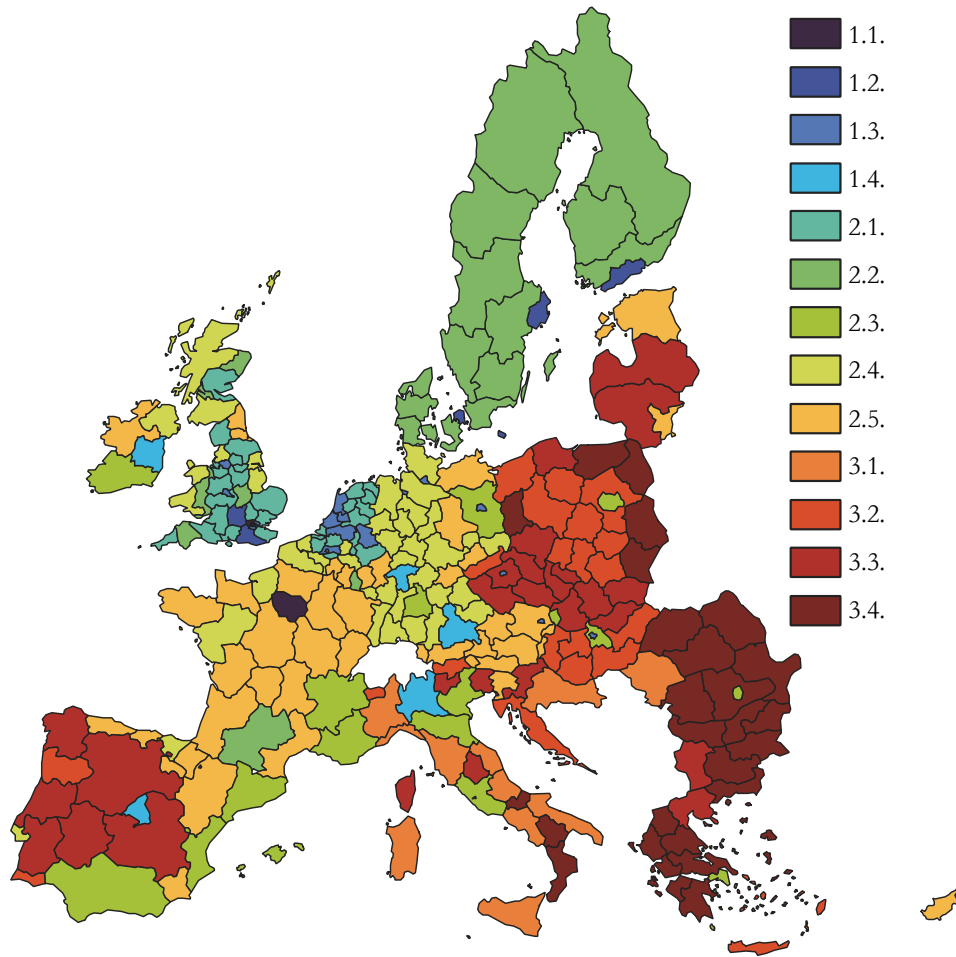## The classification of EU-28 NUTS 2 regions based on the 'Material–non-material asset relations' component
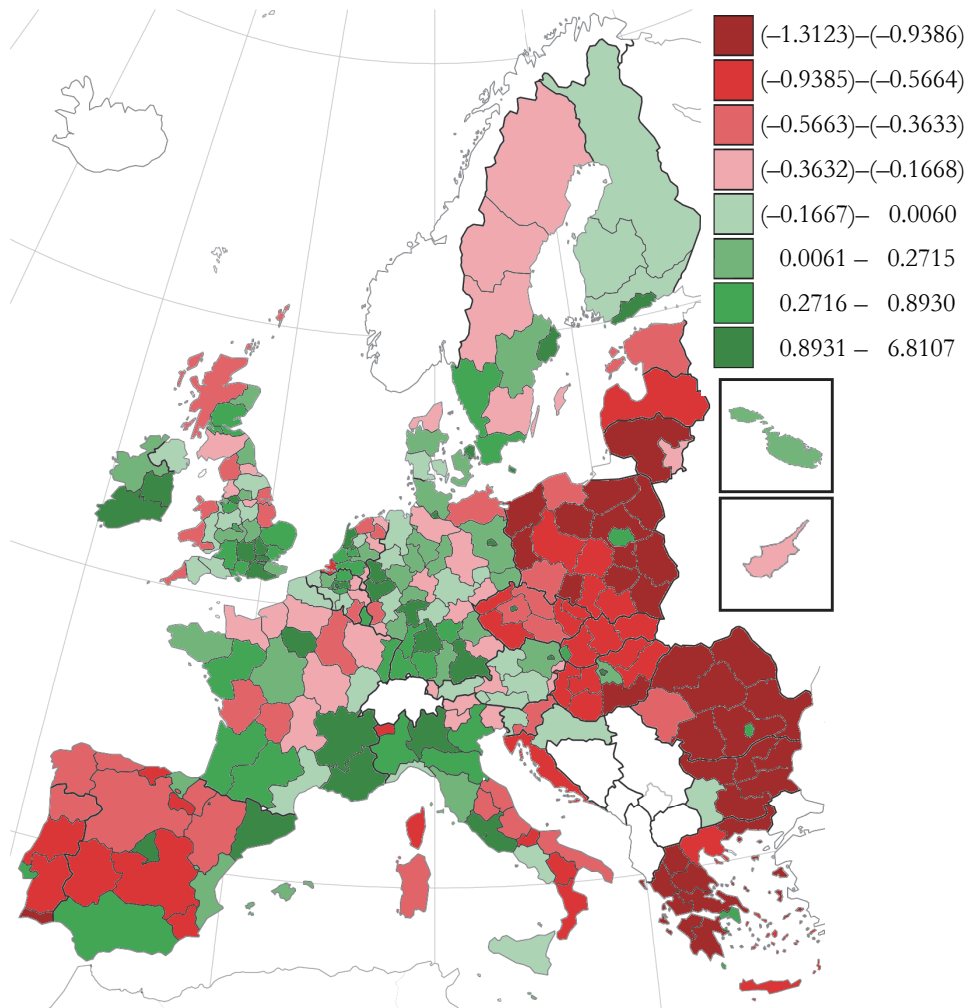
The classification of EU-28 NUTS 2 regions based on territorial capital

Legend: 1.1. Regions with extremely high territorial capital endowment; 1.2. Regions relatively highly endowed with territorial capital, significant capacities in non-material assets; 1.3. Regions relatively highly endowed with territorial capital, significant capacities in material assets; 1.4. Regions relatively highly endowed with territorial capital, significant capacities in material–non-material asset relations; 2.1. Regions with considerable capacities in material assets and well-endowed with non-material assets; 2.2. Regions with considerable capacities in non-material assets and moderately endowed with material assets; 2.3. Regions with average territorial capital endowment, developing capacities in material–non-material asset relations; 2.4. Regions with average territorial capital endowment, developing capacities in material assets; 2.5. Regions lacking capacity in terms of territorial capital; 3.1. Regions relatively scarcely endowed with territorial capital, very weak capacities in non-material assets; 3.2. Regions relatively scarcely endowed with territorial capital, very weak capacities in the material–non-material asset relations; 3.3. Regions relatively scarcely endowed with territorial capital, very weak capacities in material assets; 3.4. Regions with extremely scarce territorial capital endowments.

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