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# Behavioral Explanations of Spatial Disparities in Productivity: The Role of Cultural and Psychological Profiling

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## Abstract

This article argues that theories of economic development and productivity should move beyond the generally known factors and mechanisms of such development. It is theoretically proposed and empirically illustrated that differences in human behavior are significant deep-rooted causes of spatial economic and productivity disparities. The article examines the relationship between behavioral constructs and productivity using data for local areas across England. Measures of personality psychology and community culture (including both living culture and cultural heritage) are hypothesized to be related to activities impacting upon productivity performance at the local level. The analysis indicates that underlying human behavioral factors play a role in determining rates of productivity and levels of economic development in localities and regions. Culture and psychological traits, as manifested in the form of the psychocultural behavior of localities and regions, appear to shape their long-term development trajectories. Localities that have relatively atomized behavioral environments with high levels of individual commitment tend to enjoy productivity benefits. Similarly, places with high rates of cultural diversity and extravert individuals have relatively high rates of productivity. It is concluded that from a policy perspective, governments looking to *level up* local and regional economies should pay greater attention to understanding behavioral influences on productivity, especially related to strategies focused on behavioral nudges, institutional changes, and education systems.

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## Introduction

There is a growing literature examining the factors leading to spatial disparities across regions and localities in terms of productivity performance (McCann 2016; McCann and Vorley 2020). There are often considerable differences found at the local or regional level that cannot be fully explained by more tangible resources or industrial mix alone (Aiello and Scoppa 2000; Benito and Ezcurra 2005). Indeed, there is also a long history of studies suggesting that less tangible factors may play an important role in explaining rates of economic development and productivity (Weber 1930; Schumpeter 2007). In more recent years, a growing number of data sources have been developed to investigate the impact of the behavioral aspects, especially personality psychology (Lynn and Martin 1995), and community culture (Liñán and Fernandez-Serrano 2014), of society on various forms of economic activity. Such studies have often explored behavioral measures either at the national level or in isolation from other measures, but given that there are found to be considerable variations in many of these measures across and within regions, more underlying relationships may be missed (Kaasa, Vadi, and Varblane 2013, 2014; Rentfrow, Jokela, and Lamb 2015; Huggins and Thompson 2016).

In reality, different behavioral constructs such as community culture and personality psychology are likely to interact and evolve together, or substitute for one another, and influence the productivity of particular places (Durlauf and Fafchamps 2003; Rentfrow, Gosling, and Potter 2008). Community culture generally refers to factors generating the social norms that influence the behavior of individuals (Scott 2007), while the inclusion of personality traits within the rubric of geographic behavior is recognition of the growing research stream in psychology that utilizes large personality sets in order to show the distinctiveness and meaningfulness of regional and local personality differences (Rentfrow et al. 2013; Rentfrow, Jokela, and Lamb 2015; Obschonka et al. 2015, 2016). However, an

outstanding gap in our knowledge concerns the extent to which the clustering of community culture and personality traits may influence factors such as productivity.

Based on these emerging insights, this article is based on the proposition that theories of economic development and productivity can move beyond the generally known factors and mechanisms of such development, with the aim being to analyze deeper and more fundamental causes of spatial uneven development. Influences, such as innovation, entrepreneurship, and human capital, are widely acknowledged as key levers of development and productivity differentials, but less is known as to the sources of these factors and as to why they differ in their endowment across places. The fundamental argument of the article is that differences in human behavior across regions and localities are a significant deep-rooted cause of economic and productivity disparities.

In general, both traditional and so-called alternative theories of economic development continue to pay little attention to the role of human behavior in shaping economic evolution and change, particularly within a spatial context (Reinert, Ghosh, and Kattel 2016). This is surprising given that human behavior and the local and regional economies within which individuals are situated are fundamentally intertwined. The problem for scholars and policy analysts is that such behavior does not easily fit into existing economic frameworks (Granovetter 2017). A model recently developed by Huggins and Thompson (2019) recognizes the potential for cultural and psychological factors to coevolve and interact to determine the agency that allows activities, such as entrepreneurship and innovation, to flourish, and lead to greater productivity and economic development. However, this work conceptualizes a model without testing it, and more generally, there is very limited empirical investigation as to how different types of culture (both living and heritage) and personality interact to influence economic development as measured by indicators such as productivity.

To provide further insights into this area of study, therefore, this article seeks to both extend the model and to empirically examine the relationship between behavioral constructs and productivity using data for local areas across England in the UK. Measures are utilized to reflect different personality and cultural elements of influence as identified in the substantive literature. In particular, the study generates individual measures of personality psychology and community culture that are hypothesized to be related to activities leading to heightened productivity performance at the local level.

Focusing on the relationship between behavioral constructs and productivity, the article argues that exploring the behavioral impacts on productivity at a local level may provide a better understanding as to how society can ensure that no local areas are left behind through policy processes such as those associated with *leveling up*. As a means of addressing these issues, the article attempts to answer the following research questions: (1) How do rates of productivity and human behavioral factors differ across local spatial areas? (2) To what extent are the behavioral dimensions of local areas related to rates of productivity in these areas? and (3) How do cultural and/or psychological traits alone and/or in combination potentially explain spatial disparities in productivity?

## Human Behavior and Productivity: The Role of Personality Psychology and Culture

It has been suggested that within localities and regions individual decision-making results from local influences experienced through situations that equate to the dominant cultural traits embedded within the local communities where these influences are formed (Storper 2013). Alongside this, and while acknowledging that local and regional productivity theories are largely rooted in explanations based on the location of industries and capital, there is a move toward a (re)turn to addressing the role of individual and collective behavior in

determining local and regional development outcomes (Huggins and Thompson 2016; Lee 2017; Garretsen et al. 2019). Therefore, it can be argued that behavioral explanations of productivity differences across places can be added to readily acknowledged explanations based on the nature of institutions and the accumulation of capital (Huggins 2016).

These institutional and capital accumulation theories partly explain the growing unevenness of development across a nation such as the UK. Global factors based on the changing allocation and accumulation of productive assets, such as the growth of China and other previously less economically prosperous nations, have triggered institutional changes in the UK that have impacted on the geography of economic development. For example, the national political economy associated with the period of Thatcherism led to the emergence of structural legacies within regions and localities that now have the lowest levels of productivity. In particular, the process of deindustrialization within the UK led to the rapid decline of those localities and regions with an economic history based on extractive industries and manufacturing (Beynon and Hudson 2021). A potential upshot of this decline is that the human behavioral profile of these left-behind places impacts on the current productive capacity of these places (Rodríguez-Pose 2018). Therefore, it is possible that the behavioral profile of a place can add explanatory power to understanding spatial differences in productivity and uneven development more generally. Such a behavioral understanding may sit alongside institutional and capital accumulation theories.

Given the above, this study is based on the assumption that particular behavioral psychocultural components are associated with economic activities that promote the productivity of places. In particular, it is argued that the sources of behavior across regions and localities are codetermined by factors that combine microprocesses and macrostructure in the shaping of sociospatial community culture and personality psychology. Personality psychology refers to one of the predominant paradigms in behavioral psychology that seeks

to understand and measure differences in personality traits across individuals (McCrae and Terracciano 2005). Within studies of geographic personality, the measures normally considered are those associated with the so-called Big Five framework of personality traits, consisting of

- (1) openness—the tendency to be open to new aesthetic, cultural, or intellectual experiences;
- (2) conscientiousness —the tendency to be organized, responsible and hardworking;
- (3) extraversion —an orientation of one’s interests and energies toward the outer world of people and things rather than the inner world of subjective experience, characterized by positive affect and sociability;
- (4) agreeableness —the tendency to act in a cooperative unselfish manner; and
- (5) neuroticism (cf. emotional stability) —a chronic level of emotional instability and proneness to psychological distress, while emotional stability is largely the opposite and concerns predictability and stability in emotional reactions, with an absence of rapid mood changes (Goldberg 1992).

Although the majority of work on personality psychology has examined the impact of individual personality traits on a variety of outcomes, an idiographic perspective suggests that a more holistic view should be taken (Rentfrow et al. 2013). This idiographic perspective refers to understanding behavior through a configuration of differing traits, which at a geographic level facilitates an investigation of the extent to which particular configurations of traits occur with some regularity in specific localities and regions (Rentfrow et al. 2013). Certain configurations of traits have been found to be good predictors of developmental outcomes such as achievement at school (Hart, Atkins, and Fegley 2003); the development of social support networks and the likelihood of having spells in unemployment (Caspi 2000);

and age-related health outcomes such as the prevalence of strokes and heart disease (Chapman and Goldberg 2011).

In terms of the relationship between personality psychology and more economic factors, studies have suggested that those individuals who, on average, have higher levels of conscientiousness, openness, and extraversion make a greater contribution to regional and local economic activities that promote productivity outcomes (Obschonka et al. 2015; Lee 2017; Fritsch, Obschonka, and Wyrwich 2019). Certain personality traits may allow individuals to form networks (openness and extraversion) and provide the perseverance and organization (conscientiousness) required to maintain and improve productivity. They are also more likely to have lower levels of neuroticism and possess the self-efficacy to overcome any difficulties they face (Hartman and Betz 2007). Low levels of agreeableness are also advantageous in terms of autonomy and making difficult decisions (Rauch and Frese 2007). A number of studies have confirmed that the presence of this personality profile is positively associated with economic activity such as entrepreneurship at the regional level (Obschonka et al. 2015).

Other studies have also found evidence that these personality traits are related to the types of innovation activity that may boost regional and local rates of productivity (Lee 2017; Fritsch, Obschonka, and Wyrwich, 2019). Indeed, there is a wealth of evidence pointing to the connection between innovation, entrepreneurship, and productivity (Acs, Audretsch, and Lehmann 2013; McCann and Vorley 2020). Based on the existing evidence, it can be argued that a Conscientious-Openness-Extravert (COE) personality profile within local areas is likely to be associated with those economic activities that promote productivity. This leads to the following hypothesis:

**H<sub>1</sub>:** Rates of productivity will be higher in localities with personality profiles that are high in traits related to conscientiousness, openness and extraversion (a COE personality profile).



Alongside the psychological aspects of behavior, the concept of culture generally refers to the way in which people behave, often as a result of their background and group affiliation. Guiso, Sapienza, and Zingales (2006, 23) define it as “those customary beliefs and values that ethnic, religious and social groups transmit fairly unchanged from generation to generation.” Rather than concerning individual behavior, it relates to shared systems of meaning within and across ascribed and acquired social groups (Hofstede 1980). Van Maanen and Schein (1979) suggest that culture can be defined by the values, beliefs, and expectations that members of specific social groups come to share, while Hofstede (1980) refers to it as the collective programming of the mind, which distinguishes one group or category of people from another. It principally constitutes the social structure and features of group life within cities and regions that can generally be considered to be beyond the economic life of such places (Huggins and Thompson 2016).

As culture concerns the overarching or dominant mind-sets that underlie the way in which regions and localities function, as well as the decisions of individuals within these cultures, it may have an arbitrary coherence as people try to ensure they behave in a way that is consistent with the collective culture as well as past decisions (Ariely 2008). To address this, scholars such as Tubadji and Pelzel (2015) have sought to distinguish between cultural heritage and living culture. Heritage reflects aspects of culture from the period prior to that under investigation. Tubadji and Pelzel (2015) argue that it can be best captured by drawing on Bourdieu’s (1986) objective cultural capital, which is embodied in assets inherited from the past such as the presence of historical parks and castles or defensive walls. Living culture is more closely associated with the previous descriptions of culture and how cultural attitudes are expressed such as through theaters, cinemas, and libraries.

Much of the extant literature has made cultural comparisons at a national level (Hayton and Cacciotti 2013), but in recent years there have been more studies that have

utilized data at a regional or local level to consider the influence of local and regional community culture on economic development (Huggins and Thompson 2015). This research has established a model of *community culture*, which corresponds to Tubadji and Pelzel's (2015) concept of living culture rather than cultural heritage. The argument that living culture may have a positive impact on economic development is less concerned with the direct encouragement or constraint of particular activities but is more related to influencing the type of human capital developed (Bourdieu 1986). For example, it may attract particular types of individuals through the cultural amenities available in a place, such as Florida's (2002) creative class, who are more likely to engage in highly productive activities.

Huggins and Thompson (2015) argue that five component factors of community culture are of principal importance in the context of economic development, namely,

- (1) engagement with education and work —partly drawing on Weber's (1930) enduring notion of the work ethic and attitudes to economic participation;
- (2) social cohesion (cf. social diversity) —relating to Durkheim's (1893) notion of mechanical and organic solidarity social cohesion, whereby trait similarities and interdependence among individuals result in a perceived unity, togetherness, and less likelihood of exclusion;
- (3) femininity and caring attitudes —relating to Hofstede's (1980) typology of national cultures and the notion of the femininity or masculinity of these cultures, with masculine cultures considered to be more competitive and materialistic than their feminine counterparts, which are more caring and harmonious in their outlook—we appreciate that to some extent this typology could be considered stereotypically outdated, but the idea of cultural femininity endures within the literature (Shneor, Metin Camgöz, and Bayhan Karapinar 2013), and in order to connect with this literature we utilize this typology

- (4) adherence to social rules —referring to the acknowledged role of such adherence for coordination purposes (Rodríguez-Pose and Storper 2006) but also noting that it may constrain creative and innovative behavioral intentions; and
- (5) collective action (cf. individual action) —referring to the extent to which regions and localities adopt equity-driven cooperative action approaches as opposed to more individualistic action approaches (Johnstone and Lionais 2004).

A growing body of existing work indicates that forms of community culture that can be expected to promote higher levels of productivity are likely to be high in engagement with education and employment (Bright 2016); and high in social diversity (Florida 2002) and a preference for individual over collective activities (Huggins and Thompson 2015), which can be labeled as an *Engaged-Diverse-Individualistic* (EDI) cultural profile. This means it can be hypothesized as follows:

**H<sub>2</sub>:** Rates of productivity will be higher in localities with cultural profiles that are high in traits related to engagement, diversity and individualism (an EDI cultural profile).

H<sub>2</sub> argues that different local cultures form through combinations of particular cultural dimensions. These cultural combinations affect the behaviors pursued in particular places in a similar fashion as to how Hofstede's (1980) measures have examined national cultures. However, measures of culture more closely associated with the perspectives of Bourdieu (1986) focus on the concept of cultural capital, whereby there is a stock of culture that can be drawn upon whether or not this is held by an individual or contained in an object. In the case of living culture, this is expected to attract productive individuals (Florida 2002) or enhance the opportunities for those with access to it (Bourdieu 1986). However, cultural heritage may constrain development as it generates path dependencies, which can limit the opportunities

available for the population of particular areas (Tubadji and Pelzel 2015). It can therefore be expected that cultural heritage will negatively influence those activities that increase productivity.

**H<sub>3</sub>:** Rates of productivity will be lower in localities with higher levels of cultural heritage.

Taken together, culture and personality psychology form the underlying behavior of an economy, and may have the potential to be persistent and deeply rooted in previously dominant economic activities (Stuetzer et al. 2016), with their influence felt many decades later and continue to impact upon contemporary rates of productivity. Furthermore, consistent with the trait route, studies have found significant overlap between community culture measures and the presence of certain personality traits (Audretsch et al. 2017). Rentfrow, Gosling, and Potter (2008) explain how personality and culture are likely to coevolve rather than be independent, which is in line with research suggesting that in the long-term the genetic and cultural evolution of humans is interactive, that is cultural-genetic coevolution (Van den Bergh and Stagl 2003). This coevolution is similar to theories of *generation* and *collective memory*, as well as notions such as *generational units* of meaningful collectives that move through time with high degrees of self-awareness (Lippmann and Aldrich 2016). Others similarly suggest that the values individuals adopt are produced by their social and cultural experiences as well an element that is genetically inherited (Knafo and Spinath 2010; Schermer et al. 2008).

In the long term, any perspective on regional development would do well to acknowledge that the genetic evolution of humans, including personality, and their cultural evolution are interactive, with the interaction of cultural and biological evolution giving rise to such cultural-genetic coevolution (Van den Bergh and Stagl 2003). This means that it is quite

possible that personality and community culture in the regional context coevolve to complement one another.

Therefore, given a supportive EDI culture and a large proportion of the population having a COE personality profile, it is reasonable to hypothesize that personality profiles and community cultures will interact in a positive fashion:

**H4:** Local rates of productivity will be positively associated with the interaction between COE personality profiles and EDI cultural profiles.

The opposite effect can be expected to be true for cultural heritage, whereby the constraints imposed on the community will hold back those with more innovative or entrepreneurial personality traits.

**H5:** Local rates of productivity will be negatively associated with the interaction between COE personality profiles and cultural heritage.

Similarly, the EDI culture may have less potential to legitimize entrepreneurial and innovative behaviors to boost productivity where cultural heritage constrains such activities.

**H6:** Local rates of productivity will be negatively associated with the interaction between EDI cultural profiles and cultural heritage.

An alternative possibility raised in relation to the interactions between culture and institutions is that a substitute relationship could exist (Durlauf and Fafchamps 2003). In this case stronger cultures develop to compensate for the lack of strong formal institutions, whereby localities with higher levels of individuals with COE personality profiles may be encouraged

to engage in productive economic activities even if the prevailing community culture does not support such activities in the mainstream community and workplace.

As well as influencing the behaviors seen as acceptable by those with COE personality traits, cultural heritage is likely to constrain the extent to which an EDI cultural profile will form. Mechanisms such as self-selecting migration will lead to those with COE personality profiles being attracted to areas with an EDI cultural profile. Drawing together the theoretical and conceptual strands outlined above, Figure 1 highlights the broad framework steering the empirical analysis presented below. This builds from work, such as Rentfrow, Gosling, and Potter (2008) who illustrate the potential for culture and personality to coevolve, as well as studies such as Audretsch et al. (2017) and Huggins and Thompson (2019), which leads to the suggestion that this coevolution may create particular psychocultural profiles. These profiles may constrain or promote particular behavior and subsequently productivity.

Building upon this, it is useful to further incorporate Tubadji and Pelzel's (2015) perspective on culture-based development and the role played by cultural heritage in providing a potential resource, but also moderating the influence of living culture and constraining its development. Therefore, it is first proposed that a fundamental building block of differences in productivity across local and regional areas is related to differences in behavioral factors across these places. Second, it is argued that the interaction between psychological and cultural factors underpins the spatially bounded psychocultural behavioral footprint of any locality or region. In addition, cultural heritage has the potential to moderate the influence of the COE personality and EDI cultural profiles. Third, it is proposed that an individual's personality psychology and the sociospatial culture of the locality or region in which they are located determine their intention to behave in a particular manner. Certain aspects of this behavior, in the aggregate, will impact upon the types of economic activity in which people are engaged in their locality or region. Subsequently, rates of productivity and

development across localities and regions will depend on the nature of human behavior within these places, which is dependent on the evident underlying psychological and cultural traits. The economic development associated with these activities and resultant productivity will feed back to the culture and personality present as well as the ultra-slow evolution of cultural heritage. It would also be reasonable to expect the living culture associated with the EDI cultural profile to influence the evolution of cultural heritage but with a considerable lag.

[PLEASE INSERT FIGURE 1 ABOUT HERE]

## Data and Methods

This section outlines the methodological approach adopted to quantitatively analyze how local behavioral factors concerning cultural and personality dimensions may relate to economic success. The empirical analysis for this study focuses on England, with a number of studies noting that there are persistent differences in the economic success of localities within the country (Gardiner et al. 2013). As existing research has found considerable differences in both personality and culture within regions, the unit of focus is on local authority district areas and considers 310 areas across England. The areas are not perfect in terms of being functional economic and social areas, instead being based on local government responsibility, but they do allow access to a wider range of data than alternatives such as travel to work areas.

In order to examine the independent and combined influence of personality psychology, community culture, and cultural heritage, it is necessary to produce a measure for each that is theoretically associated with productivity. In studies of personality and cultural measures, multiple dimensions are often devised, which reflect the multifaceted nature of these concepts. However, from a personality perspective, studies suggest that it is

not the presence of individual personality characteristics that are important for driving particular behaviors, but rather the presence of particular combinations either at the individual level (Obschonka, Schmitt-Rodermund, and Terracciano 2014) or area level (Rentfrow et al. 2013). This has led to some studies devising composite measures that capture the extent to which this ideal combination for promoting a particular behavior is present (Obschonka, Schmitt-Rodermund, and Terracciano 2014). As discussed below, this study follows these approaches by using combinations that theoretically should promote activities to boost productivity. Individual dimensions will be used for robustness checks as well as to gain a deeper understanding of what drives any associations found.

For the personality psychology measures, the Big Five allow previously developed measures of personality to be integrated through the provision of a set of clear and easy to interpret measures (John and Srivastava 1999). Therefore, this study adopts the Big Five approach to capturing personality differences, given the widespread use of these measures in the empirical literature on personality traits. The data to create the personality measure is drawn from the British Broadcasting Corporation's (BBC) Lab UK website as part of the BBC's and University of Cambridge's Big Personality Test project. A total of 588,014 individuals across the UK completed the online survey. Respondents were required to sign up for a BBC ID to ensure that they did not complete the survey twice. The instrument used to collect the data is the Big Five Inventory (John and Srivastava 1999). This consists of forty-four short statements associated with the prototypical traits of the five personality traits. Respondents were asked to indicate their agreement with these statements on a five-point Likert scale ranging from 1 disagree strongly to 5 agree strongly. Principal components analysis (PCA) is used to generate the five underlying measures. A varimax rotation is applied to generate distinct measures that are easier to identify. This data has been previously used by Rentfrow, Jokela, and Lamb (2015) to map the distribution of personality in Great



Britain using the aggregated data at the local authority level, and they provide a detailed examination of the Big Personality Test data and its representativeness at the local authority district level.

The correlation between the sample sizes and actual local authority district populations is 0.84. There is also found to be a strong correlation between the local authority area sample characteristics with those of the underlying population in terms of ethnic background ( $\rho \geq 0.84$  for individual ethnic groups) and median age ( $\rho = 0.79$ ). Therefore, it is found that there is a good match between the respondents and the underlying population. However, it should be noted that while the detailed examination of the Big Personality Data by Rentfrow, Jokela, and Lamb (2015) indicates it is representative, it is still a self-selecting sample, and there is the potential for those with particular personality traits to participate in greater numbers than others. However, there is no reason to suspect that any such bias would distort relative differences across localities.

The personality measures for each local authority area are represented as the average of the individual personality traits of respondents in the area. Studies, such as Bell (2007) and Mathieu et al. (2014), have noted that for groups operating together, it is not necessarily the mean personality values that are important, but rather the distribution and the maximum or minimum values that are important for the functioning of groups. Concerns have also been noted as to whether or not items in self-reported measures are interpreted consistently across groups (gender or age groups) (Hussey and Hughes 2020). This potential issue and the possible correlation between self-reported measures and the extent measures reflect socially desirable responses implies that future work might be advised to consider the extent to which culture also influences this interpretation and responses (Holden and Passey 2010). However, virtually all studies of geographic personality have adopted the common approach of considering the mean of an area's entire population, since this is found to be strongly related

to outcomes at these geographic levels (Rentfrow, Jokela, and Lamb 2015), and is therefore the approach adopted here.

The approach used to develop a single idiographic measure of personality psychology at the local level is adopted from Obschonka et al. (2020), who take the highest measures of the Big Five personality dimensions associated with entrepreneurial behavior at the local level to be a proxy for economic activities within localities leading to higher productivity through competition and innovation (Du and O'Connor 2018). Within this profile conscientiousness, openness, and extraversion (COE) have the highest values, with the lowest values achieved for agreeableness and neuroticism. Therefore, the COE label is used to represent the fact that conscientiousness, openness, and extraversion are the most prevalent personality traits associated with behavior this profile seeks to capture. For each measure, the method adopted is to consider the distance of each locality from the highest (COE) and lowest (agreeableness and neuroticism) values. The negative inverse of these is taken to represent localities closer to the hypothetically most potentially productive orientated locality and sum these elements.

For community culture, the five dimensions developed by Huggins and Thompson (2015) are utilized (see Table A1 of the online appendix for further information on source data). As already indicated, these are developed to reflect dimensions stemming from existing measures of community culture, including Weber (1930) and Hofstede (1980). Unlike other measures available at the national and regional level, the measures are based on secondary data following a similar approach used by Chinni and Gimpel (2011), which allows the measures to be produced at much lower levels of aggregation. A potentially productivity-oriented community culture measure can be developed using Obschonka et al.'s (2020) approach outlined above. Given the literature discussed in the preceding section, it would be expected that a productive community culture is likely to have above average levels of

engagement with education and employment, social diversity, and preferences for individual activities (EDI cultural profile), as well as having below-average levels of involvement with feminine and caring activities and adherence to social rules. In order to allow a better comparison between the COE personality and EDI cultural measures, the approach was to standardize the variance of each to 1.

Tubadji and Pelzel (2015) use the presence of city walls and historic gardens to capture the presence of cultural heritage in their study of Germany. We adopt a similar but broader measure to the physical artifacts that reflect the preservation and retention of cultural capital from previous periods. Rather than concentrating on a relatively small subset of contributions of this type, especially as most city walls, for example, in the UK have been demolished or only fragments remain, we use the National Heritage List for England listing of structures for preservation (see the online appendix for further details). We consider the listed buildings per head in each area of England to measure the level of cultural heritage available per person.

The productivity measure used in the study is drawn from the Office for National Statistics's balanced measures of gross value added (GVA) for local authority districts. In order to provide a better measure of output per worker, this figure is divided by employment as captured by the Business Register and Employment Survey (BRES). Employment includes both employees and those working as employers. This helps to provide an overall measure of those contributing toward production, and provides a measure of GVA per employee. In order to help reduce issues associated with reverse causality, the latest available data (2017) for GVA at the local authority level is utilized.

To more fully assess the mechanism through which personality and culture may influence productivity through activities, such as entrepreneurship, we also run regressions utilizing gross firm formation and net firm formation per head of capita.

In order to examine the relationship between the COE personality profile (*Pers*), EDI cultural profile (*CultLiv*), and cultural heritage (*CultHer*) and productivity (*Prod*), regression analysis controlling for other influences that are associated with productivity are utilized. This will allow the testing of *hypotheses H<sub>1</sub>, H<sub>2</sub>, and H<sub>3</sub>*.

$$Prod_i = \alpha_0 + \beta_1 Pers_i + \beta_2 CultLiv_i + \beta_3 CultHer_i + \boldsymbol{\gamma Controls}_i + \varepsilon_i \quad (1)$$

Specifications are regressed for the productivity of local authority *i* on the COE personality profile, EDI cultural profile, and cultural heritage measures, allowing each to act independently. However, this does not account for how these three potential influences on productivity may interact as outlined in *hypotheses H<sub>4</sub> to H<sub>6</sub>*. In order to account for these the following equation is estimated:

$$Prod_i = \alpha_0 + \beta_1 Pers_i + \beta_2 CultLiv_i + \beta_3 CultHer_i + \beta_4 Pers_i \cdot CultLiv_i + \beta_5 Pers_i \cdot CultHer_i + \beta_6 CultLiv_i \cdot CultHer_i + \boldsymbol{\gamma Controls}_i + \varepsilon_i \quad (2)$$

As adding multiple interaction terms can make the interpretation more complex, the restrictions on each of  $\beta_4$ ,  $\beta_5$ , and  $\beta_6$  being set equal to zero are relaxed in different estimations. All the cultural and personality variables included in the regressions are centered to enable easier interpretation.

An alternative perspective, as set out by authors, such as Tabellini (2010), Tubadji and Pelzel (2015), and Stuetzer et al. (2016), is that historical measures, such as those used to represent cultural heritage, can reflect the culture and institutions that leave a lasting imprint on current personality psychology and contemporary culture (COE personality and EDI culture). This means that they can be used as instruments for the more contemporaneous

measures of personality and culture to reduce issues of endogeneity when considering whether or not any relationships with productivity are causal. To account for this, an instrumental variables regression can be run as follows:

$$\widehat{Pers}_i = \alpha_{10} + \beta_{11}CultHer_i + \beta_{12}CoalField_i + \gamma_1Controls_i + \varepsilon_{1i} \quad (3)$$

$$\widehat{CultLiv}_i = \alpha_{20} + \beta_{21}CultHer_i + \beta_{22}CoalField_i + \gamma_2Controls_i + \varepsilon_{2i} \quad (4)$$

$$Prod_i = \alpha_{30} + \beta_{31}\widehat{Pers}_i + \beta_{32}\widehat{CultLiv}_i + \gamma_3Controls_i + \varepsilon_{3i} \quad (5)$$

The first stage regressions (3) and (4) estimate the presence of the COE personality and EDI cultural profiles, respectively, using cultural heritage as an instrument. Since there are two variables being treated as endogenous, a second instrument is required. Stuetzer et al. (2016) examine the impact of large-scale industrialization on personality and account for endogeneity by instrumenting with distance from coalfields. This reflects the importance of transport costs, which led to large scale production in the nineteenth century being concentrated in close proximity to coalfields. Therefore, we use the distance from coalfields as a second instrument, although the adequacy of the instrument for personality will need to be confirmed, since it no longer operates through the intermediary of large-scale production. The significance or otherwise of  $\beta_{31}$  and  $\beta_{32}$  will act as a robustness check of the results from equations (1) and (2) in relation to hypotheses  $H_1$  and  $H_2$ .

As alluded to above, as well as using the compound measure of the COE personality profile the influence of individual traits are checked. Further robustness checks conducted include controlling for spatial spillovers. In particular, it may be expected that interlocality commuting patterns may influence the personality and cultural profiles of nearby localities and subsequently their productivity. Although productivity measures are not available in the BBC data, it is possible to use individual-level income and self-employment as proxies for

productivity and entrepreneurship, respectively, in multilevel random intercept regressions where community culture and cultural heritage enter at the local level.

The vector of controls (*Controls*) used in the regressions above includes measures of industrial diversity and industrial specialization based on Fotopoulos's (2014) measures. The share of employment in manufacturing and finance is also controlled, reflecting those sectors commonly associated with higher levels of productivity. The potential influence of agglomeration is captured by population density as measured by 10,000 people per square kilometer. Transport infrastructure is represented by the presence of a major airport (serving four million passengers) within twenty-five miles, a primary maritime port (serving one million passengers or twenty-eight million tons of freight) within forty kilometers, and rail connections as represented by rail journeys per head of population. Lastly, formal institutions are controlled for using the measures generated by Huggins and Thompson (2016), which are based on Charron, Dijkstra, and Lapuente's (2014) Quality of Government measures.

## **[level1]Results**

Figure 2 illustrates that there is a concentration of the most productive localities in the southern parts of England. The least productive localities are generally in the northern and southwestern parts of England. Of those localities included in the analysis, the median rate of productivity as measured by GVA per employee is £51,537 and the mean is £54,767 (see Table A2 in online appendix), which are US\$66,483 and US\$70,649 at an average exchange rate of 1.29 US dollars to 1 pound Sterling in 2017. As would be expected, the most productive localities are local authority areas in the regions of London, the South East of England and East of England. The top ten most productive localities all have an average rate of productivity of between £88,000 and £114,000 per annum. In somewhat stark contrast, the ten least productive localities have rates ranging from £36,000 to just under £41,000. This indicates that when examining spatial differences in productivity and economic development

through the lens of local level performance, there are highly significant divides, which adds to existing evidence that uses different spatial units of observation (Martin et al. 2016).

[PLEASE INSERT FIGURE 2, 3, and 4 ABOUT HERE]

Moving on to the behavioral variables, Figure 3 presents the distribution of the personality profile measure across localities, and shows there to be a concentration of personality profiles with high rates of conscientiousness, openness, and extraversion (COE) in the southeasteastern areas of England. Figure 4 illustrates the distribution of the community cultural measure across localities, indicating that the EDI cultural profile—that is high in engagement with education and employment, social diversity, and preferences for individual activities—is very uneven across the nation. London has by far the greatest proportion of such cultural traits, and London’s boroughs are the only ones represented in the top twenty localities. Overall, the figures suggest that not only is there a north-south economic divide across England there is also a north-south division in terms of behavioral psychoculture.

Table 1 shows the correlation matrix for the variables included in the following regression analysis, and given the results presented above, it is unsurprising to find that both the personality and cultural profile measures are positively and significantly related to productivity. These relationships are also depicted in Panels A and B of Figure 5. Consistent with Tubadji and Pelzel’s (2015) suggestion, that unlike the living culture —captured by the EDI cultural profiles —cultural heritage imposes constraints on the population socially and economically. A negative relationship is found between productivity and the cultural heritage variable (Figure 5 Panel C).

[PLEASE INSERT FIGURE 5 ABOUT HERE]

Table 2 presents the regressions of productivity on these behavioral variables. In all cases, the regressions can reject the null of collective insignificance. The regressions explain between 33 percent and 52 percent of the variance in local productivity. When no other controls are included, both the COE personality profile and the EDI cultural profile are positively associated with productivity. The coefficient on the cultural profile is larger, indicating that a change of one standard deviation for community culture has a stronger impact on the productivity than average personality. This is reasonable given the theory relating to personality psychology and community culture, whereby the latter is a group held construct, and therefore changes to it may affect the whole local population and legitimize innovative and entrepreneurial behaviors (Huggins and Thompson 2019). Cultural heritage, on the other hand, has a negative relationship with productivity, which is consistent with Tubadji's (2013) concept of culture-based development. Both the cultural measures and the personality measure are significant at the 1 percent level.

[PLEASE INSERT TABLE 1 AND TABLE 2 ABOUT HERE]

Controlling for other influences, the personality profile is significant at 5 percent or better. The results, therefore, provide support for *hypothesis H<sub>1</sub>*, so that localities with personality profiles richer in traits relating to COE tend to experience higher rates of productivity.

With regard to the role of the EDI cultural profile, the results indicate strong support for *hypothesis H<sub>2</sub>*, with there being a highly significant relationship between the EDI cultural profile measure and local rates of productivity. Community culture is a highly localized and embedded phenomenon, and it is likely to be a long-term predictor of productivity. Higher rates of engagement with work and employment can naturally be expected to boost productivity through human capital gains. Social diversity may engender the types of



tolerance and cross-fertilization that can heighten economic development and productivity (Florida 2002). It also appears that a preference for *individualism* over *collectivism* is positively related to productivity (Casson 1995). Given contemporary spatial voting patterns in the UK, this makes intuitive sense and possibly reflects the individual commitment found in the most productive localities being a manifestation of a *personal competitiveness* that subsequently becomes visible at an aggregated spatial level (Mehta 2014).

The controls allowed to enter the regressions in Models 2 and 3 of Table 2 show the importance of cluster effects and potentially related variety (Jacobs 1969), with both industrial specialization and diversification being positively related to greater productivity. In both cases there is the potential for knowledge spillovers that allow for greater innovation and growth (Crespo, Boschma, and Balland 2017). Related to the former impact, it is no surprise that the concentration of the finance industry—which accounts for a considerable proportion of economic growth in the UK and is highly clustered within Greater London—is positively associated with higher output per head. Accounting for this indicates significantly more similarity in workers’ efficiency across localities (Beatty and Fothergill 2019).

Population density is negatively associated with productivity, and there is an extensive literature on old, often urban, industrial regions and how lock-in can lead to them persistently lagging with limited opportunity for path creation or renewal (Hassink 2010). After controlling for other influences, there is no significant influence from a reliance on manufacturing for employment. Initially, it may appear counterintuitive that the quality of formal institutions is negatively associated with productivity, but if culture strengthens to substitute for weak institutions at the local level, this may be the dominant effect (Durlauf and Fafchamps 2003).

In Models 4, 5, and 6 of Table 2, we allow different interactions to take place between the COE personality profile, EDI cultural profile, and cultural heritage variables. These

potential moderating effects are also depicted in Figures 6 to 8. The interactions with cultural heritage in Models 5 and 6 with the COE personality profile and EDI cultural profile, respectively, are insignificant. This means there is no support for *hypothesis H<sub>5</sub>* and, and while cultural heritage appears to directly hold back development by constraining those activities that might drive growth, there is no evidence that it dissuades those of a more entrepreneurial nature. Similarly, it does not appear to override the support that the EDI cultural profile provides (Model 6 and *hypothesis H<sub>6</sub>*).

[PLEASE INSERT FIGURES 6, 7 AND 8 ABOUT HERE]

Instead, it appears that after controlling for culture and the other more traditional cluster and agglomeration influences discussed above, it is the presence of a supportive living culture and personality profile (EDI cultural profile and COE personality profile) that in combination generate higher levels of productivity as predicted by *hypothesis H<sub>4</sub>*. This is consistent with Rentfrow, Gosling, and Potter's (2008) suggestion that complementary personality traits and community culture will form. Model 4 of Table 2 is the one regression where the COE personality profile variable appears to be less influential, with the main effect only significant at the 10 percent level. Figure 6 illustrates that the marginal effect of the COE personality profile is insignificant when a supportive EDI cultural profile is not present and only starts to have a positive effect for areas with above-average levels of the EDI cultural profile (positive values of the centered variable).

It is important to categorize areas depending on what combination of above or below average COE personality and EDI cultural profiles they possess (see Figure A1 in the online appendix). The South East of England and London hold the vast majority of areas with potentially the ideal combination of personality and cultural profiles. Old industrial areas in

the North and Midlands of England tend to have neither, and the South West of England contains many areas with higher levels of COE personality but lack the EDI cultural profile to support them. The South East and East of England appear to have a number of localities where the EDI cultural profile is present, but there is less evidence of COE personalities. An explanation for this is that selective migration has seen many of these more entrepreneurial individuals fall into the gravitational pull of the relatively nearby London.

Of course, the relationship between personality psychology, community culture and productivity is unlikely to be a direct one. As indicated by Figure 1, the relationship will work through an intermediate factor whereby the type of human behavior and agency stemming from the personality profile of a locality will have a long-term influence on the nature and efficiency of economic activities in this locality. As highlighted earlier, personality profiles will impact on the known drivers of productivity relating to the innovation, entrepreneurship, and competitive-drive undertaken and employed by local firms and organizations (new and old), which in the long-term also determines local industrial structure (Rentfrow, Jokela, and Lamb 2015; Lee 2017; Garretsen et al. 2019). Similarly, it will be the behavior and agency that culture spawns, and the way it informs and influences local economic activity, structure, and efficiency, which subsequently impacts upon spatial productivity differences (Carree and Thurik 2010).

To provide insights into these mechanisms, the regressions are rerun with gross new firm creation and net new firm creation used as the dependent variables and reported in the online appendix Tables A3 and A4. The EDI cultural profile is positively related to both gross and net business creation, and the COE personality profile is positively associated with gross business creation.

A considerable literature has developed that analyzes geographic patterns of personality; however, it is the case that personality is held by the individual (Cattell 1943), while culture is held at the group level (Beugelsdijk and Maseland 2011). From this alternative perspective, it would be appropriate to consider if individual level productivity is driven by a combination of the individual's personality traits and/or the local community culture present. In order to check whether such a relationship exists, the regressions are repeated using a multilevel random intercept specification using the microlevel BBC data for those aged eighteen to sixty-four living in England.

Unfortunately, no productivity measure is available, so the imperfect proxy of household income is used along with individually estimated measures of the COE personality profile (Table A5 in the online appendix). Specifications are run that allow for an interaction with both the EDI cultural profile and cultural heritage to see if these area level influences moderate the relationship between personality and income. It is found that the COE personality profile is more positively associated with the proxy for productivity than the EDI cultural profile at the area level, which is to be expected given that personality can now more directly impact individual decisions. Cultural heritage is not found to have a significant impact. The EDI cultural profile is found to moderate and strengthen the individual effect of the COE personality profile.

We also use a multilevel logit regression to analyze if personality and culture relate to the likelihood of being self-employed. Again, at the individual level it is the personality profile that has the largest effect in boosting self-employment. No significant result is found for the EDI cultural profile, but cultural heritage does positively relate to self-employment (Table A6 in the online appendix).

To check for the robustness of the COE personality and EDI cultural profiles relationship with productivity, there is also the need to account for causality. Following the approach used by studies, such as Stuetzer et al. (2016) and Tubadji and Pelzel (2015), we use measures associated with the historical development of personality and culture as instruments for the COE personality and EDI cultural profiles. In this case, the COE personality profile is more strongly related to cultural heritage in a positive manner (Table A7 in the online appendix). The EDI cultural profile is negatively related to cultural heritage, as predicted by Tubadji and Pelzel (2015), and positively related to the distance from coal deposits. The EDI cultural profile remains positively related to productivity (*hypothesis H<sub>2</sub>*).

Given the small areas of analysis used in the study, it is plausible that productivity levels may be affected by the personality and cultural profiles of nearby areas. To account for this, we also assess the impact of allowing a spatial lag of the personality and cultural measures (Table A8 in the online appendix). The COE personality profile spatial lag is positive, implying that an area may benefit from being surrounded by areas with more *entrepreneurial* people present, since they either commute and work in and/or collaborate with others in the area. A negative spatial lag coefficient is found for the EDI cultural profile, which would fit with the argument that relatively close areas with more supportive cultures draw enterprising individuals away (Rentfrow et al. 2013). A final check considers the personality traits individually for comparison with the compound COE personality profile (see online appendix Tables A9 and A10).

## Conclusions

This study has examined the influence of human behavior in the form of personality psychology and community culture on productivity both independently and in combination with one another. The analysis points to a confirmation of the hypotheses that the underlying sociospatial community culture and aggregate personality psychology found in particular localities are likely to play a role in determining rates of productivity and levels of economic development in these places. Given this, the cultural and psychological traits, as manifested in the form of the psychocultural behavior of localities and regions, appears to shape their long-term development trajectories. Localities that have relatively atomized behavioral environments with high levels of individual commitment tend to enjoy productivity benefits. Similarly, places with high rates of cultural diversity and extravert individuals have relatively high rates of productivity.

It is concluded that behavioral factors encompassing culture and personality psychology potentially provide new insights into the persistence of the long-term spatial unevenness of productivity. Spatial patterns of behavior and the interactions between cultural and psychological factors result in the formation of localized behavioral systems with a higher or lower propensity to sustain long-term productivity. As indicated above, the relationship between human behavior and productivity is unlikely to be a direct one, and it is likely that behavior initially impacts upon other sources of productivity, such as the form and efficiency of local economic activity, as well as the capability and capacity to generate and mobilize the types of capital required for high rates of productivity.

From a policy perspective, the findings presented above indicate that governments looking to *level up* local and regional economies should pay greater attention to understanding behavioral influences on productivity. Unless this occurs, policies to promote

productivity improvements are likely to lead to further spatial disparities and inequalities. In particular, the integration of behavioral theories of economic development are likely to yield a better understanding of the most effective mix of policies and investments seeking to facilitate productivity gains and economic development.

Regional development theory is largely rooted in explanations based on the organization of firms, industries, and capital within particular locations, as well as the institutions that either incentivize or constrain the manner in which these firms and industries operate, alongside the way in which particular forms of capital are allocated. This results in the levers of productivity being usually considered to consist of factors such as skills, infrastructure, machinery, equipment and research and development, the leadership and managerial capability of firms, as well as the role of policy at multiple levels in shaping the capacities associated with each lever (McCann 2016; McCann and Vorley 2020). This is undoubtedly the case, but this study makes the case that differences in human behavior across places—based on the psychological and cultural profiles of these places—play a complementary role in understanding productivity and development divides. Clearly, the determination of productivity gaps is a highly complex area that a myriad of scholars continue to explore. Within this framework, a greater appreciation of the human behavioral profile of a place can potentially form a vital cog in stimulating economic development as part of a more holistic series of investments and policy interventions.

In this vein, the traditional policies advocated for economic development retain their importance but should be regarded in relation to the personality and cultural implications noted above. The outcome of this behavioral appreciation could lead to a number of policy actions, for example, the implementation of a series of interventions that seeks to catalyze the behavioral change required to enhance the potential effectiveness of traditional economic development policies. However, another approach would be to seek alternative policies that

are more attuned to the behavioral profile of a region or locality. Examples of this are the use of social and foundational economy-related policies that are seeking to foster development in a number of lagging regions and localities.

Both approaches may yield success, but policies formulated to catalyze behavioral change are likely to be considered more controversial given their potentially cultural deterministic connotations. In recent years behavioral public policies have become synonymous with the *nudge* concept, which seeks to address choice architectures that may alter people's behavior, but do not forbid any options or significantly change economic incentives (Thaler and Sunstein 2008). Some see such nudges as a dangerous shift toward public policy that seeks to socially engineer behavior without due consent. However, nudges are of course not the only mechanisms public policy makers are able to draw upon as a means of influencing behavior, and generally there are two other routes that have long formed the foundation of behavioral public policy prior to the more recent acknowledgment of the role of nudges: first, the role of regulation and its ability to either incentivize or constrain particular forms of behavior, which we can more readily refer to as *institutions* (North 2005); and second, the provision of information and knowledge especially that provided through education, training, and other learning environments (Berndt 2019). Therefore, behavioral public policies should best be considered as a suite of levers consisting of behavioral nudges, institutional change, and education systems.

The findings of this study on the relationship between human behavior in places and the productivity of these places provides evidence that integrated intervention is required across these levers, if improved prosperity is to be realized for many regions and localities in the future. For example, the finding that COE personality profiles are only significantly related to increased productivity when supported by the presence of an EDI cultural profile indicates that improving productivity in places that possess a high COE personality profile



will prove highly challenging if these places lack a cultural profile also high in EDI. Of course, this contention could be configured and proposed in many different ways, but it all points to the need for a fuller appreciation and understanding of the behavioral side of development. Without this, many—and maybe the majority—of public investments will continue to underperform and not provide value for money.

Finally, from a methodological perspective the compressing of different dimensions of personality and culture into a composite measure for each allows the two to be interacted, but future studies should recognize that particular combinations of each may yield different economic and social outcomes (Rentfrow et al. 2013; Audretsch et al. 2017). Furthermore, this study has been constrained by looking at a single point in time, and time series would be an important means of examining how personality and cultural profiles change over time. Similarly, the extent to which these profiles relate to larger social and structural changes would provide a fuller understanding of their association with productivity outcomes.

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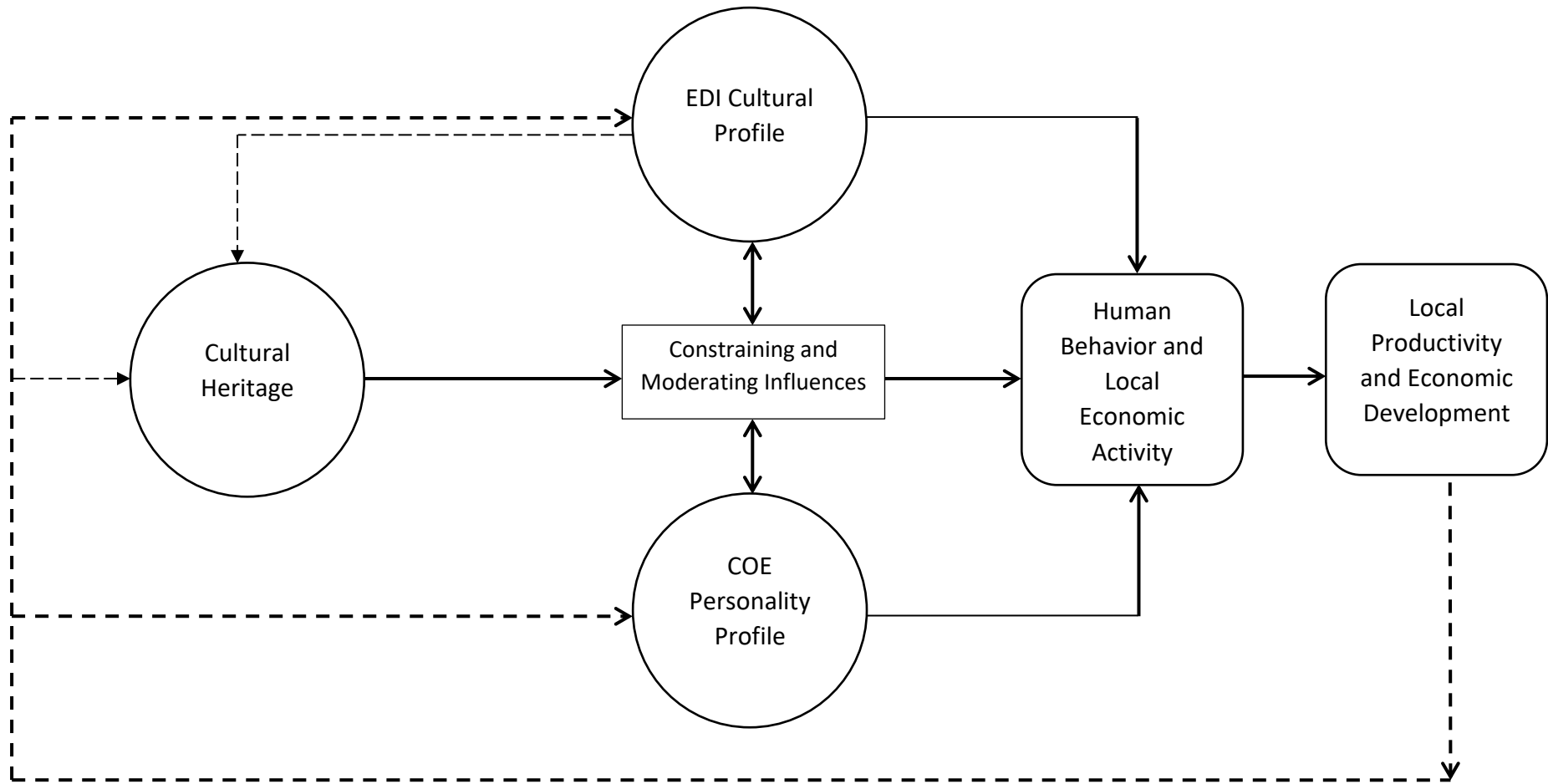


Figure 1. A behavioral framework for analyzing local productivity.

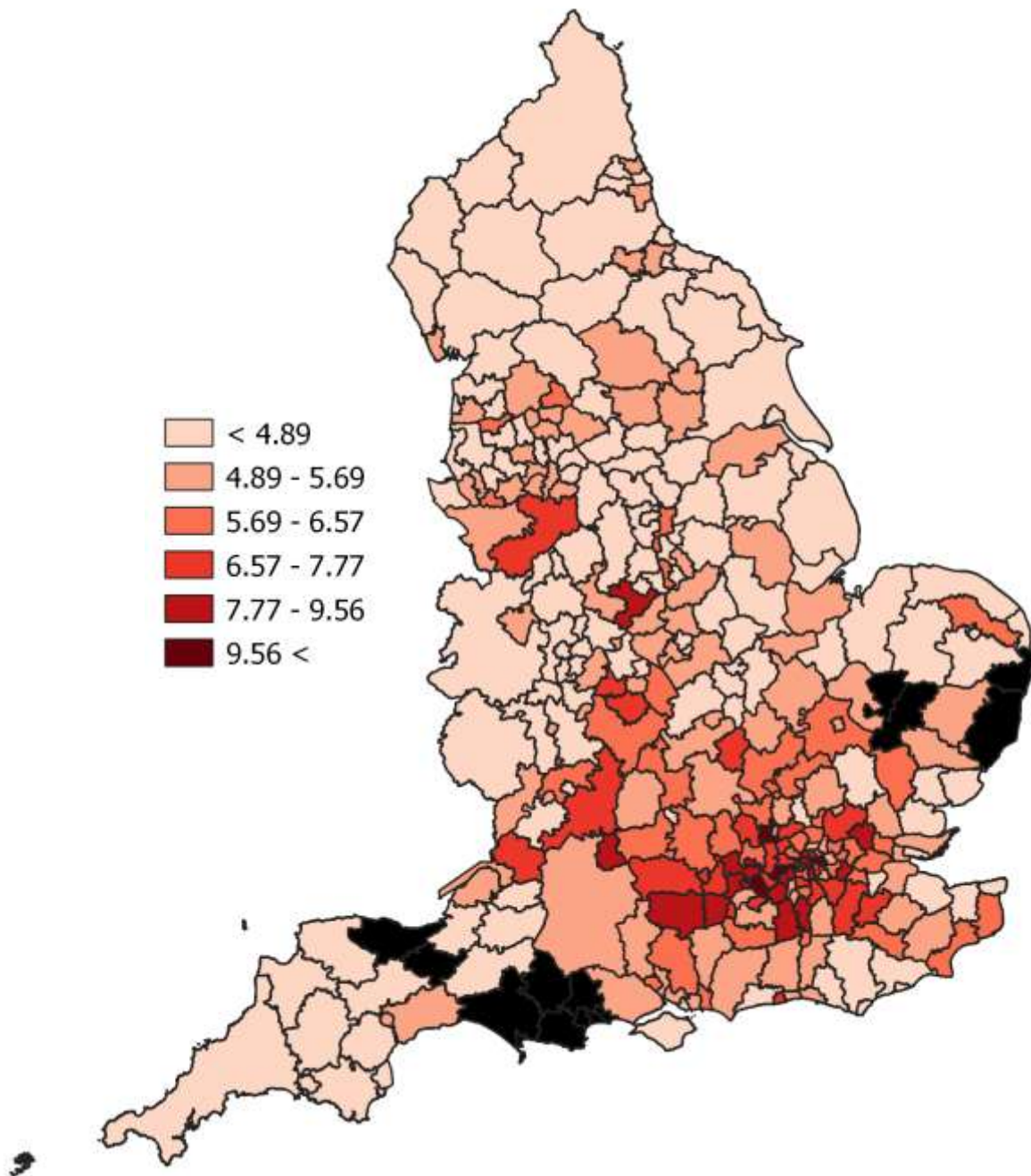


Figure 2. Distribution of GVA per employee (£10,000s) in England (2017).

Note: Areas marked in black reflect missing values due to the amalgamation of local authority districts.

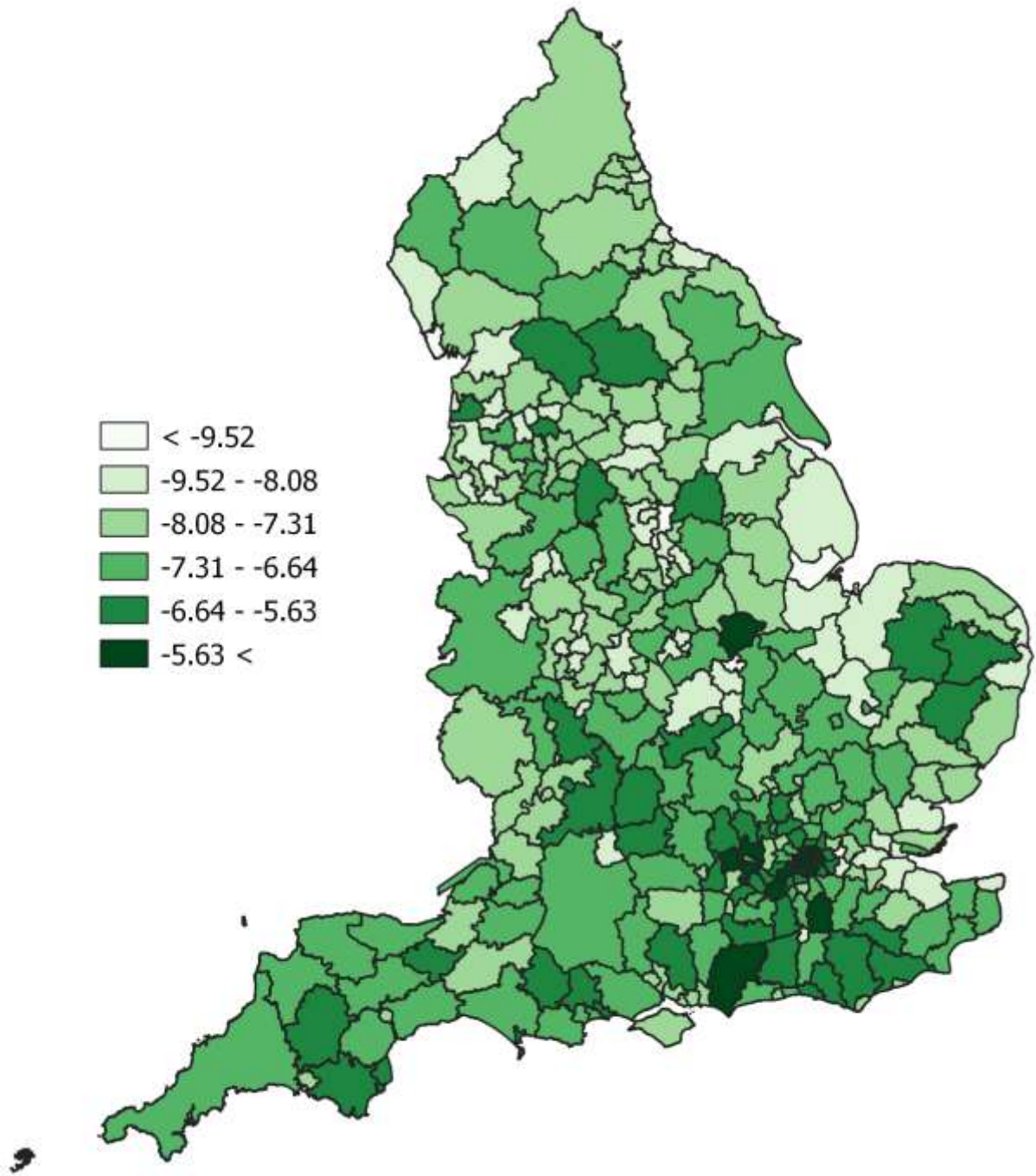


Figure 3. Distribution of the COE personality profile in England (2010).

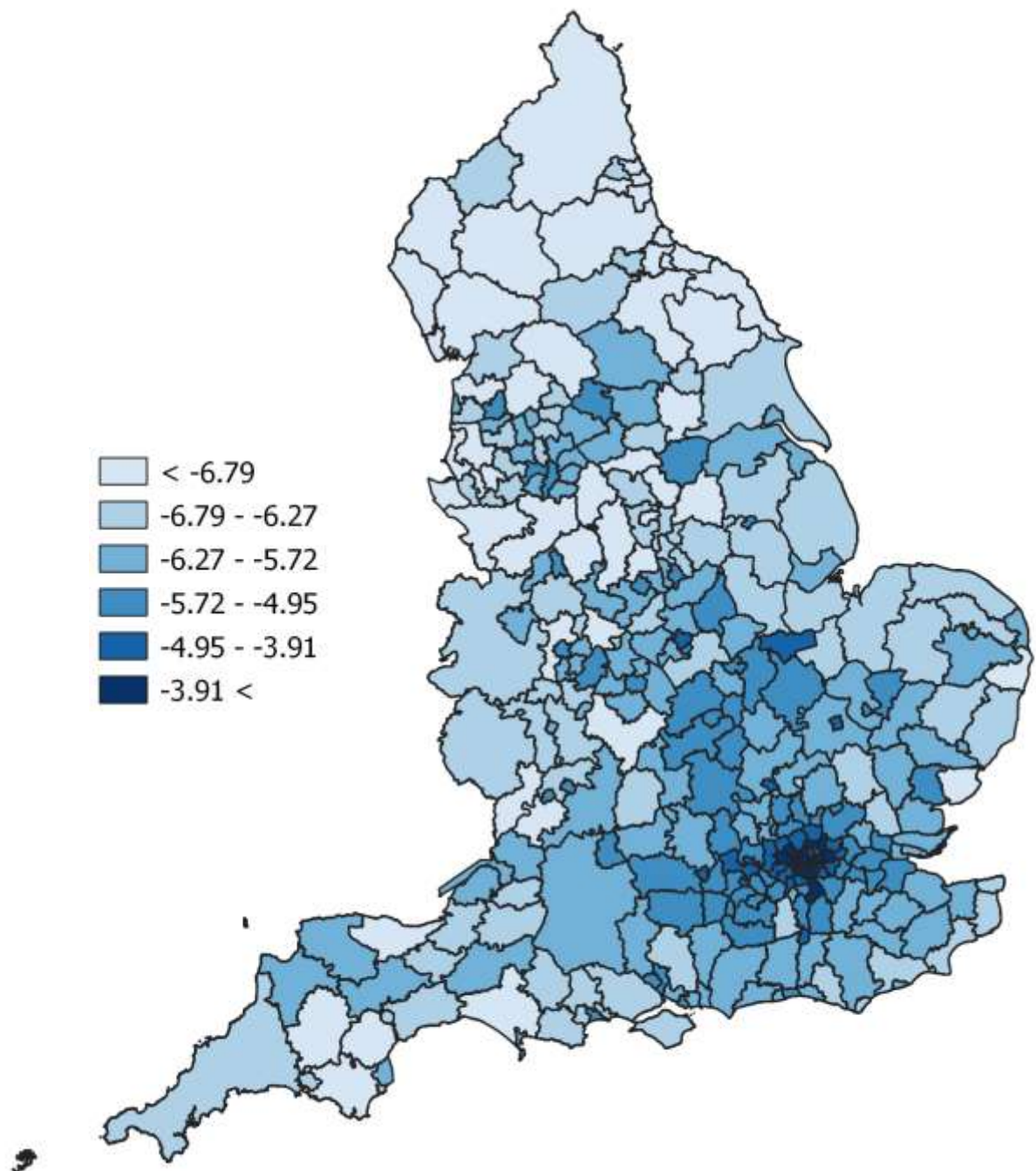
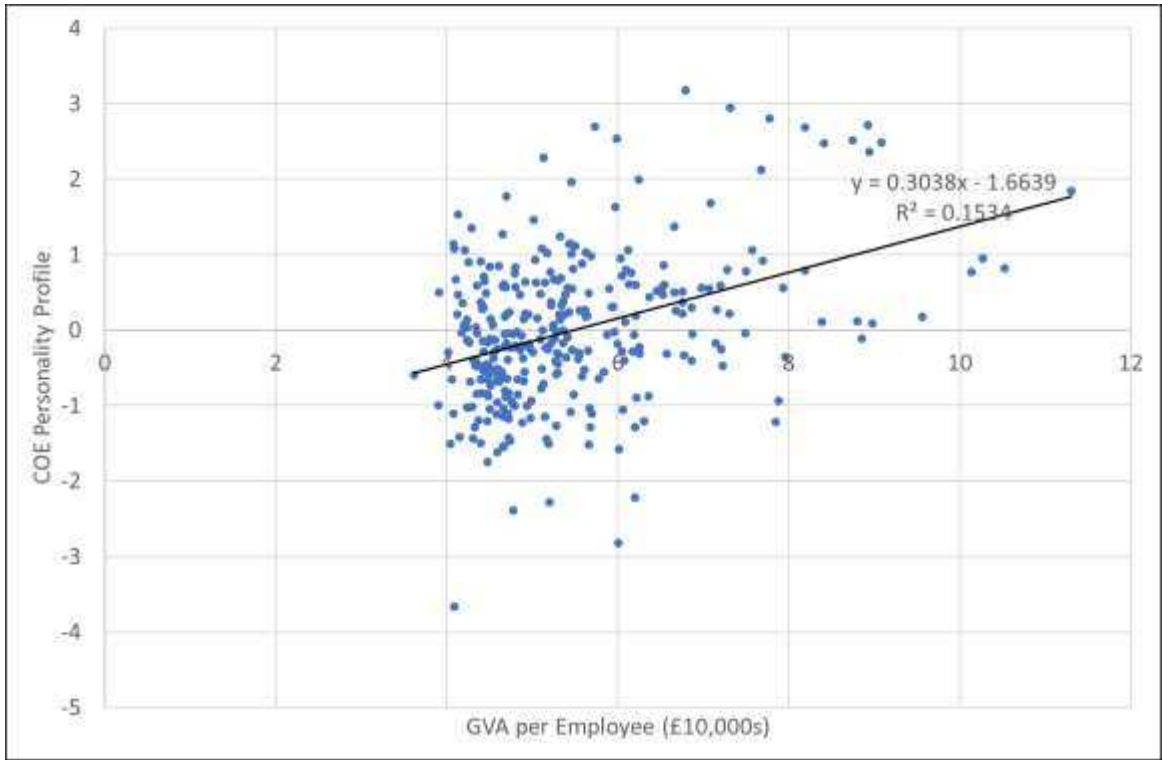
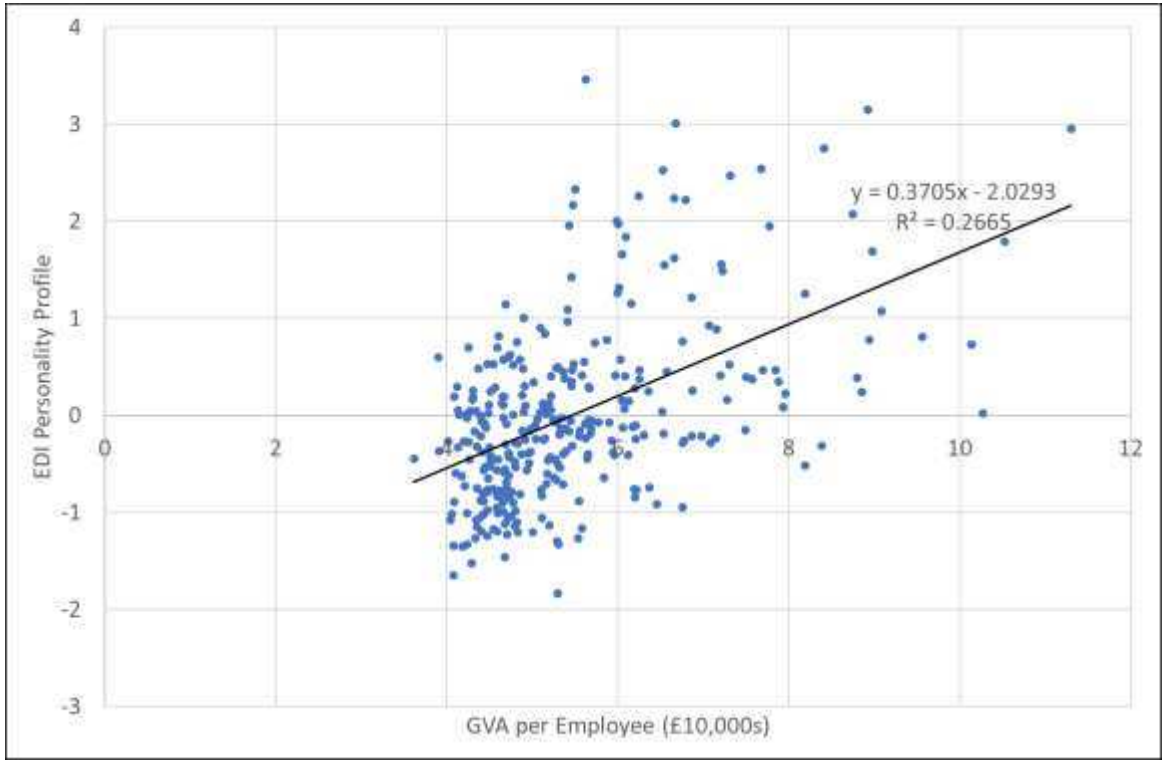


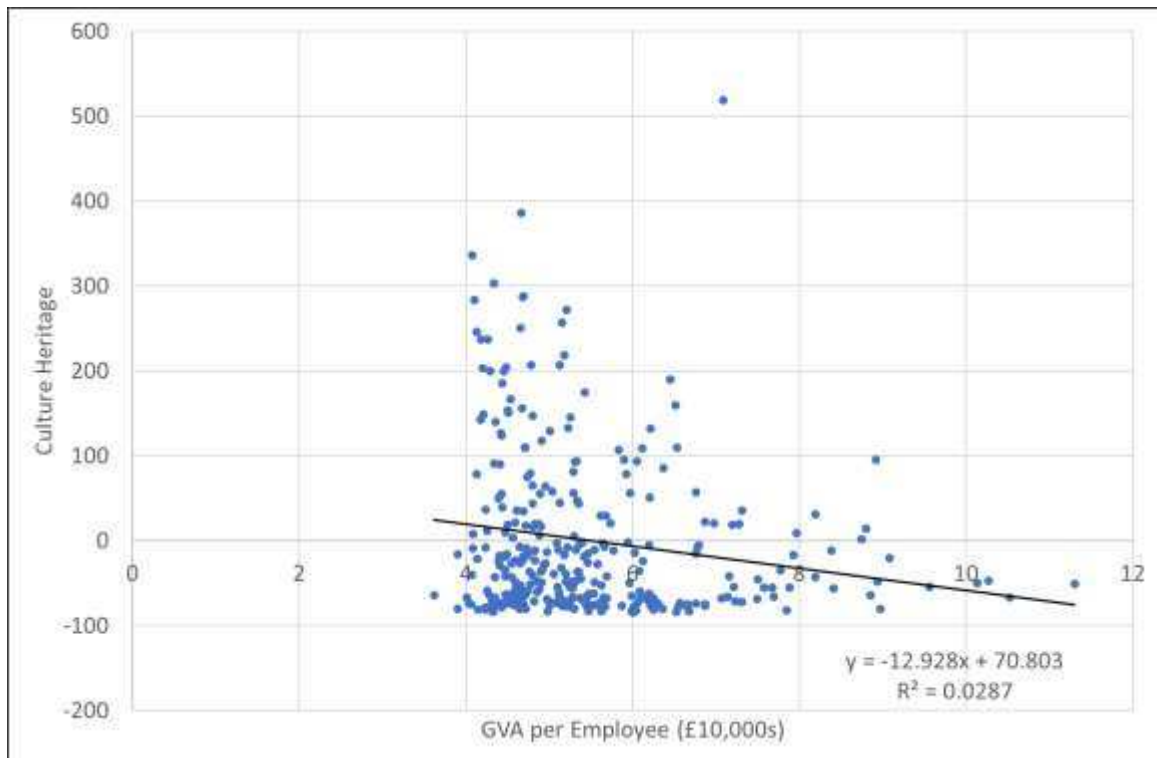
Figure 4. Distribution of the EDI cultural profile in England (2010).



Panel A. Local gross value added per employee in 2017 and COE personality profile.



Panel B. Local gross value added per employee in 2017 and EDI cultural profile.



Panel C. Local gross value added per employee in 2017 and cultural heritage.

Figure 5. Scatter diagrams of local gross value added per employee in 2017 and personality and culture measures.



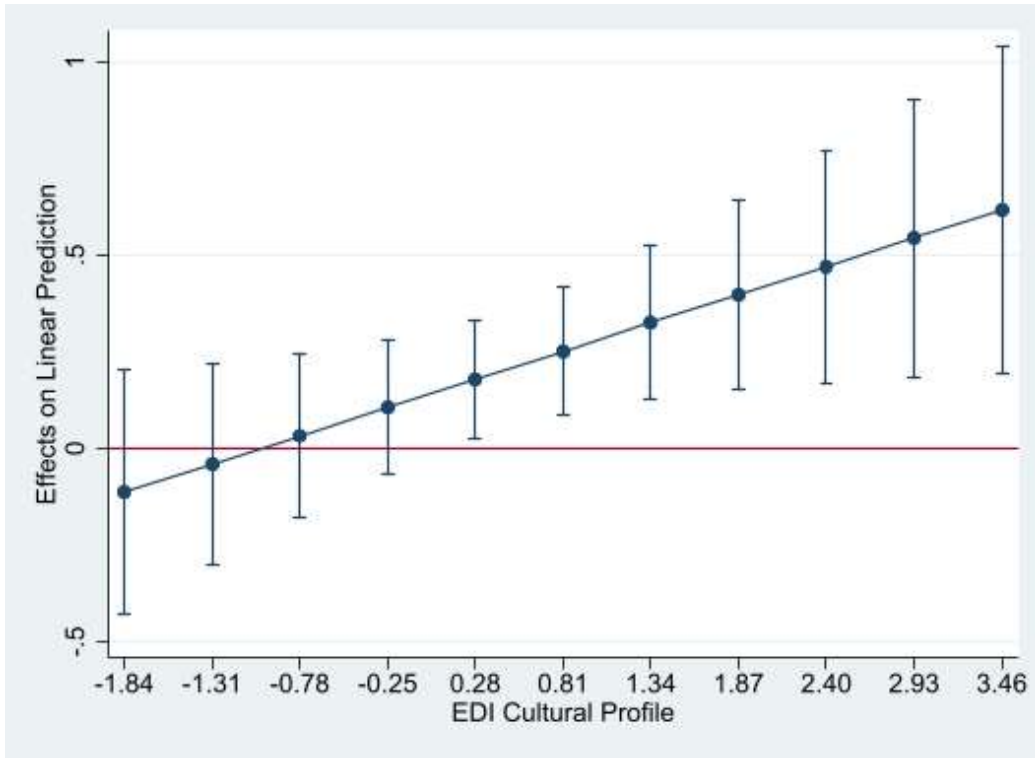


Figure 6. Interaction of the COE personality profile and the EDI cultural profile (marginal effect of COE personality profile).

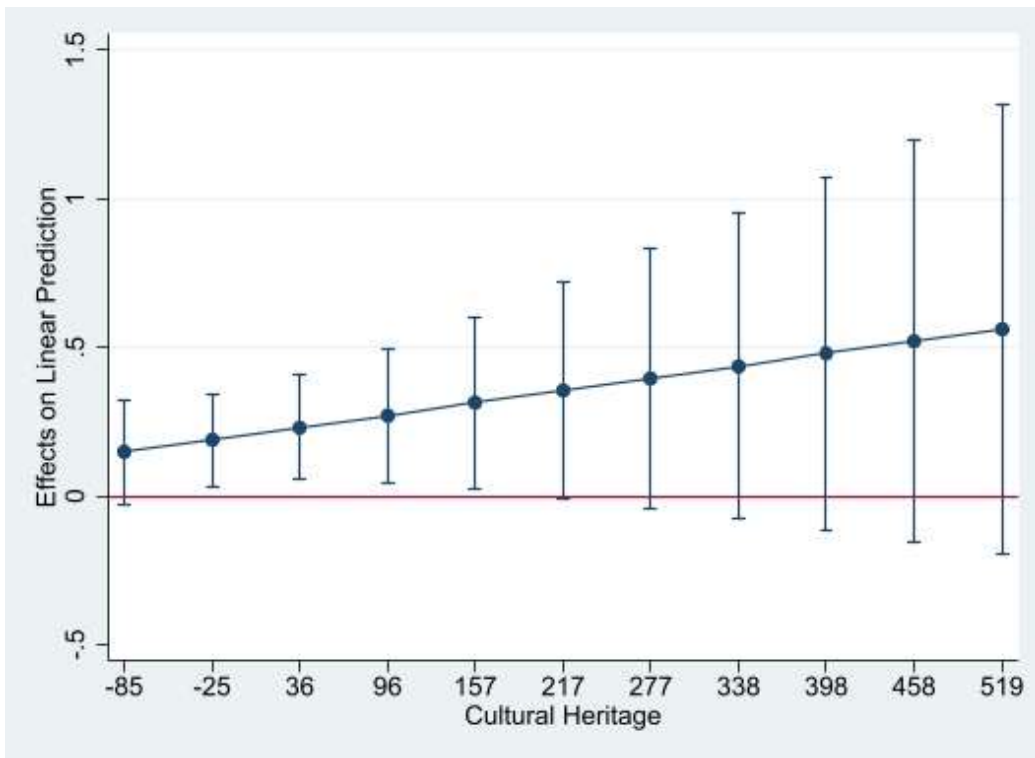


Figure 7. Interaction of the COE personality profile and cultural heritage (marginal effect of COE personality profile).

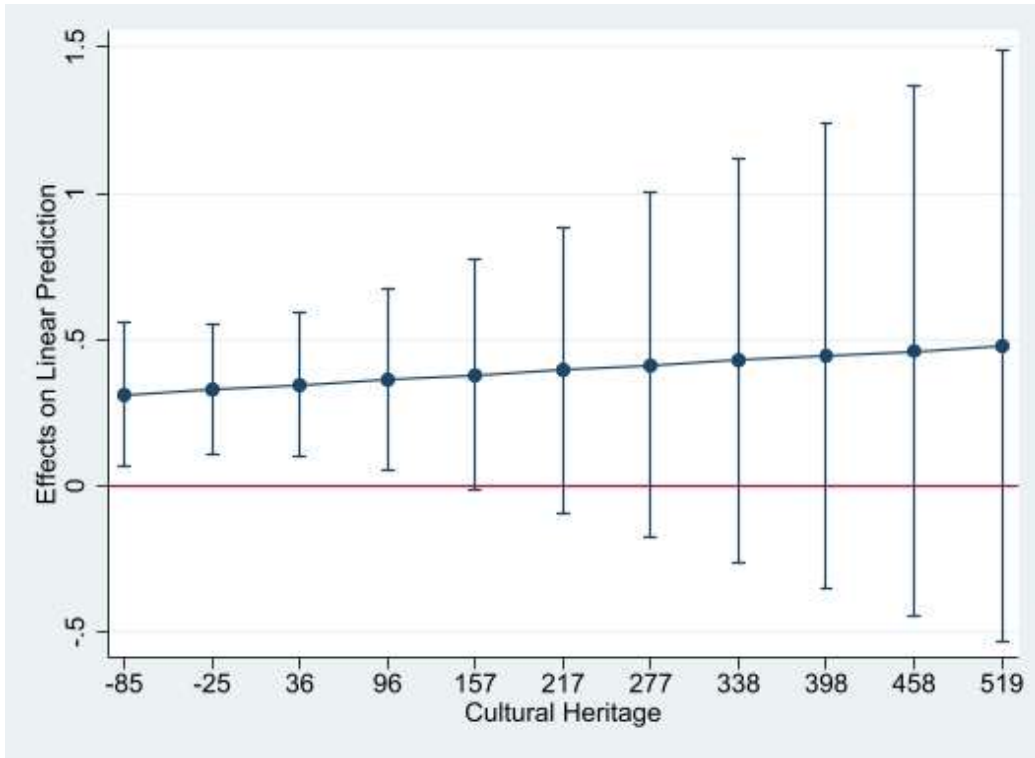


Figure 8. Interaction of the EDI cultural profile and cultural heritage (marginal effect of EDI culture profile).

**Table 1***Correlation Matrix*

	1. GVA per Employee	2	3	4	5	6	7	8	9	10	11	12
2. COE Personality Profile	0.392 (0.000)											
3. EDI Cultural Profile	0.516 (0.000)	0.363 (0.000)										
4. Cultural Heritage	-0.170 (0.003)	0.288 (0.000)	-0.308 (0.000)									
5. Finance Employment	0.543 (0.000)	0.554 (0.000)	0.528 (0.000)	-0.055 (0.336)								
6. Manufacturing Employment	-0.342 (0.000)	-0.463 (0.000)	-0.376 (0.000)	0.022 (0.703)	-0.557 (0.000)							
7. Population Density	0.356 (0.000)	0.343 (0.000)	0.735 (0.000)	-0.381 (0.000)	0.486 (0.000)	-0.429 (0.000)						
8. Industrial Diversification	-0.241 (0.000)	-0.374 (0.000)	-0.493 (0.000)	0.244 (0.000)	-0.369 (0.000)	0.620 (0.000)	-0.558 (0.000)					
9. Industrial Specialization	0.146 (0.010)	-0.043 (0.450)	0.066 (0.250)	-0.012 (0.830)	-0.034 (0.556)	0.068 (0.231)	0.123 (0.030)	-0.047 (0.409)				
10. Major Airport	0.307 (0.000)	0.228 (0.000)	0.344 (0.000)	-0.321 (0.000)	0.330 (0.000)	-0.148 (0.009)	0.332 (0.000)	-0.188 (0.001)	-0.034 (0.555)			
11. Port	0.139 (0.014)	0.116 (0.042)	0.137 (0.016)	-0.214 (0.000)	0.189 (0.001)	-0.384 (0.000)	0.270 (0.000)	-0.284 (0.000)	0.022 (0.701)	0.023 (0.685)		
12. Rail Connections	0.428 (0.000)	0.411 (0.000)	0.546 (0.000)	-0.112 (0.048)	0.537 (0.000)	-0.431 (0.000)	0.564 (0.000)	-0.477 (0.000)	0.119 (0.037)	0.254 (0.000)	0.229 (0.000)	
13. Institutions	0.226 (0.000)	0.206 (0.000)	0.301 (0.000)	-0.148 (0.009)	0.298 (0.000)	-0.379 (0.000)	0.227 (0.000)	-0.260 (0.000)	-0.071 (0.209)	-0.038 (0.509)	0.317 (0.000)	0.272 (0.000)

Note: *p*-values in parentheses

**Table 2***Regressions of Local GVA per Employee in 2017 on Personality Psychology and Community Culture Profiles*

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
COE Personality Profile	0.3897 (0.000)	0.2555 (0.002)	0.1889 (0.017)	0.1397 (0.089)	0.2056 (0.011)	0.1875 (0.019)
EDI Cultural Profile	0.5043 (0.000)	0.5198 (0.000)	0.3288 (0.004)	0.3727 (0.001)	0.3260 (0.004)	0.3353 (0.004)
Cultural Heritage	-0.0019 (0.009)	-0.0025 (0.002)	-0.0025 (0.002)	-0.0024 (0.003)	-0.0029 (0.001)	-0.0024 (0.010)
COE Personality Profile*				0.1376		
EDI Cultural Profile				(0.033)		
COE Personality Profile*					0.0007	
Cultural Heritage					(0.321)	
EDI Cultural Profile*						0.0003
Cultural Heritage						(0.766)
Manufacturing Employment		-0.0329 (0.055)	-0.0107 (0.530)	-0.0170 (0.323)	-0.0107 (0.531)	-0.0121 (0.494)
Finance Employment		0.0563 (0.000)	0.0472 (0.001)	0.0428 (0.002)	0.0482 (0.000)	0.0464 (0.001)
Population Density		-1.3914 (0.000)	-0.9256 (0.036)	-1.3345 (0.005)	-0.9527 (0.031)	-0.9117 (0.040)
Industrial Diversification		6.4824 (0.000)	7.4378 (0.000)	7.5322 (0.000)	7.5055 (0.000)	7.4937 (0.000)
Industrial Specialization		2.6948 (0.000)	2.6496 (0.000)	2.6213 (0.000)	2.6827 (0.000)	2.6764 (0.000)
Major Airport		0.1376 (0.288)	0.1383 (0.297)	0.1746 (0.189)	0.1355 (0.306)	0.1436 (0.284)
Port		0.0625 (0.623)	-0.1664 (0.263)	-0.1442 (0.330)	-0.1695 (0.255)	-0.1641 (0.271)
Rail Connections		0.0023 (0.074)	0.0024 (0.053)	0.0016 (0.235)	0.0023 (0.066)	0.0023 (0.081)
Institutions		-0.0061 (0.982)	-0.6941 (0.037)	-0.6936 (0.035)	-0.6771 (0.042)	-0.6949 (0.037)
Constant	5.4767 (0.000)	-0.4279 (0.724)	-0.4654 (0.691)	-0.3398 (0.770)	-0.5533 (0.637)	-0.4844 (0.680)
Regional NUTS 1 Dummies	No	No	Yes	Yes	Yes	Yes
<i>N</i>	310	310	310	310	310	310
<i>R</i> <sup>2</sup>	0.330	0.456	0.515	0.523	0.517	0.515
F-test	50.2 (0.000)	20.8 (0.000)	15.4 (0.000)	15.0 (0.000)	14.7 (0.000)	14.6 (0.000)

Note: *p*-values in parentheses.

## Online Only Appendix: Behavioral Explanations of Spatial Disparities in Productivity: Culture, Psychology, and Economic Development

The information below provides more details of the data collection approach and items used to develop the measures employed to capture personality, living culture (EDI-cultural profile), and cultural heritage.

### Big Five Personality Measures

A lack of theoretical clarity and methodological rigor have led to a large number of different measures of personality being created (Inkeles and Levinson 1969; Le Vine 2001). Some earlier studies concentrated on norms or customs (Benedict 1946; Mead 1951) or considered national stereotypes (Peabody 1988). Recently a more common approach has developed around the Big Five personality dimensions of extraversion: agreeableness, conscientiousness, neuroticism (emotional stability), and openness (John, Naumann, and Soto 2008). The Big Five personality traits were developed from an analysis of natural language terms people use to describe themselves (Cattell 1943). Examining these traits, identified in earlier studies, Tupes and Christal (1961) suggest that the relationships between these traits meant that they could be captured or nested within five factors. This means that a set of clear and easy to interpret measures can be produced that capture the varied and diverse overlapping existing measures (John and Srivastava 1999).

The five dimensions are (John, Naumann, and Soto 2008, 138)

- **Extraversion:** implies an energetic approach toward the social and material world and includes traits such as sociability, activity, assertiveness, and positive emotionality;
- **Agreeableness:** contrasts a prosocial and communal orientation toward others with antagonism and includes traits such as altruism, tender-mindedness, trust, and modesty;
- **Conscientiousness:** describes socially prescribed impulse control that facilitates task- and goal-oriented behavior;
- **Neuroticism:** contrasts emotional stability and even-temperedness with negative emotionality, such as feeling anxious, nervous, sad, and tense;
- **Openness to experience:** describes the breadth, depth, originality, and complexity of an individual's mental and experiential life.

Because of this ability to nest other schema of personality traits, the Big Five have become the most commonly used approach in recent years. This has led to a large number of instruments being developed and tested for their ability to capture the Big Five (Credé et al. 2012). Although widely used, a limitation of the Big Five is that because they capture personality more broadly, they do not necessarily display a strong relationship with particular behaviors and attitudes (Leutner et al. 2014). However, the focus on these measures mean that large surveys have been undertaken that allow the distribution of personality traits to be mapped across countries such as the UK (Rentfrow, Jokela, and Lamb 2015), US (Rentfrow 2010), and Germany (Obschonka et al. 2019).

The data to create the personality measure in this study is drawn from the British Broadcasting Corporation's (BBC) Lab UK website as part of the BBC's and University of Cambridge's Big Personality Test project. A total of 588,014 individuals completed the

online survey. Respondents were required to sign up for a BBC ID to ensure that they did not complete the survey twice. The personality traits were measured using the Big Five Inventory, which includes forty-four short statements that respondents indicate their agreement with on a 5-point Likert scale (1 disagree strongly to 5 agree strongly). The five personality traits are identified from the forty-four individual measures using a principal component analysis and varimax rotation.

The personality measures for each local authority area are represented as the average of the individual personality traits of respondents in the area. This is the approach used in a bulk of the literature considering the geographic distribution of personality (Rentfrow 2010; Rentfrow, Jokela, and Lamb 2015). This approach can be criticized on the basis of those studies that suggest either the combination (Rentfrow et al. 2013; DiNisi 2015; Klotz and Neubaum 2016; Huggins, Thompson, and Obschonka 2018) or extreme values of personality may be more important (Felps, Mitchell, and Byington 2006; Prewett et al. 2018).

This data has been previously used by Rentfrow, Jokela, and Lamb (2015) to map the distribution of personality in Great Britain using the aggregated data at the local authority level, and they provide a detailed examination of the Big Personality Test data and its representativeness at the local authority district level. The correlation between the sample sizes and actual local authority district populations is 0.84. The mean sample size is 1,023, although there is considerable variation for individual local authority districts with the Isles of Scilly (excluded from the analysis in this article) having only 28 participants, while 5,588 respondents were located in Leeds.

There is also found to be a strong correlation between the local authority area sample characteristics with those of the underlying population in terms of ethnic background ( $\rho \geq 0.84$  for individual ethnic groups) and median age ( $\rho = 0.79$ ). Therefore, it is found that there is a good match between the respondents and the underlying population.

## Living Community Culture Measures

Studies have found considerable variation in the productivity or related concepts of competitiveness and broader development within regions of countries such as the UK or Italy (Di Giacinto et al. 2014; Beatty and Fothergill 2019). In order to examine the impact of community culture and personality on local productivity, it is necessary to have a measure of culture that can be disaggregated to the level of local authority districts. Although there are a number of well-known measures of culture available, a vast majority of these are captured at the national (Hofstede 2001) or at best regional level (Kaasa, Vadi, and Varblane 2013, 2014). This reflects the fact that most are captured using a survey approach that even in large-scale projects, such as the GLOBE study of cultural dimensions (House et al. 2004), still do not provide samples of sufficient size to disaggregate them to a local level. The only possibility of achieving this is to aggregate a number of years of data. Changes in the items used in different waves of the surveys can make consistency an issue where this is attempted.

For community culture, the five dimensions developed by Huggins and Thompson (2014) and refined by Huggins and Thompson (2016) are utilized. These dimensions are engagement with education and employment, social cohesion, feminine and caring activities, adherence to social rules, and collective actions. Unlike some previous studies, such as Hofstede (2001) and Schwartz (1992), the process of developing these dimensions was not data driven. Although the data-driven approach has the advantage of theoretically not imposing preconceptions or values from one culture on another it can be criticized where the items used are unrepresentative of culture in its wider sense. This can be where the items used relate to particular spheres of life or the sample included reflects only a subsample of the population (Kaasa, Vadi, and Varblane 2014). Instead, the dimensions developed by Huggins



and Thompson (2014; 2016) follow the approach of others by framing measures around existing measures that are found to have a solid theoretical basis (Tabellini 2010).

Unlike other measures available at the national and regional level, the measures generated by Huggins and Thompson (2016) and used in this study, are based on secondary data. This follows a similar approach to that of Chinni and Gimpel (2011) and allows the measures to be produced at much lower levels of aggregation. A potential limitation is that culture is less directly captured, but rather through activities associated with particular cultural traits in a similar fashion to the GLOBE study of cultural dimensions (House et al. 2004). Tubadji and Pelzel (2015) provide another, but related, approach based on the number of landlines associated with a more constrained group of cultural activities.

The rationale for the inclusion of each cultural dimension is provided below:

- (1) *Engagement with education and employment* captures an underlying work ethic (Weber 2001; Becker and Woessmann 2009) and orientation toward longer-term planning for work (Hofstede 2001; Tabellini 2010). Higher levels of this dimension are associated with placing a greater emphasis on self-sufficiency and making a societal contribution (Gregson, Simonsen, and Vaiou 1999; Brennan, Rhodes, and Tyler 2000; Becker and Woessmann 2009).
- (2) *Social cohesion* relates to Durkheim's (1893) notion of *mechanical* and *organic* solidarity social cohesion. It is predicted that trait similarities and interdependence generate a perceived unity and reduces the chances of exclusion. To reflect this, measures of ethnic similarity and religious similarity are used to capture homogeneity (Durkheim 1893; Rodríguez-Pose and Hardy 2015). Social cohesion of this type is expected to generate greater trust (Kwon

and Adler 2014). However, it can also isolate the group or community from individuals and ideas originating outside the group (Adler and Kwon 2000).

- (3) *Feminine and caring activities* is a cultural dimension that captures the social and work roles that are associated with each gender within the prevailing norms (Parasuraman et al. 1996; Hofstede 2001; Carter, Marlow, and Bennett 2012; House et al. 2004). This links to Hofstede's (1980) Masculine-Feminine scale where masculine cultures are considered to be more competitive and materialistic than their feminine counterparts, which are more caring and harmonious.
- (4) *Adherence to social rules* reflects the extent that social conventions are enforced through reputational effects. These are key coordination tools for maintaining accepted social norms (Rodríguez-Pose and Storper 2006; Lorenzen 2007). Where social rules are enforced, this ensures subversive activities do not become acceptable and seen as the *new* social norm (Kearns and Forrest 2000).
- (5) *Collective action* reflects a desire for equality, greater equity, social justice (Schwartz 1990), and cooperatively working for the in-group's interests rather than for those of the individual or their family (Hofstede 1980; Triandis 1993).

Huggins and Thompson (2016) provide evidence linking these measures to entrepreneurial activity, although they also note how the type of entrepreneurship (new or existing) is affected to different degrees by these measures.

To create the individual dimensions Huggins and Thompson (2016) follow the approach of Tabellini (2010) in using principal component analysis to identify the common element and where multiple components are extracted, taking the first component. A varimax rotation is applied for this eventuality to ensure that the first component is easy to interpret.

## Cultural Heritage Measures

To capture inherited culture, this study follows Tubadji and Pelzel (2015) who use the presence of city walls and historic gardens to capture the presence of cultural heritage in their study of Germany. A broader measure is used to reflect the physical artifacts that reflect the preservation and retention of cultural capital from previous periods. This uses the National Heritage List for England, which lists structures for preservation. This is the process by which buildings and other structures, such as war memorials, street furniture (street lamps), and some gravestones can be listed to prevent destruction or modification, since they are of architectural or historic special interest. The list was downloaded for this study in October 2020 and included a total of 379,064 listed buildings. The entries provide coordinates for each listed building, which were then mapped onto the English local authority districts. A small number of entries were associated with local authorities of Wales and Scotland and were removed from the data. This varies from 35 listed buildings in Castle Point in the East of England (Essex) to 12,586 in Cornwall.

This measure has an additional benefit in that anyone can apply to add a structure to the list. Those structures chosen to be included on the listing will in part be determined by those in an area's willingness to go through the application procedure. Therefore, areas with higher numbers of buildings and other artifacts listed may not just have a greater number of these, but may act as a reflection of a greater of tradition retaining such artifacts by the local population. We consider the listed buildings per head in each area of England to reflect the

amount of cultural heritage available per person. This varies from 2.46 per 10,000 people in Barking and Dagenham in London to 606.19 per 10,000 people in Cotswold in the South West.

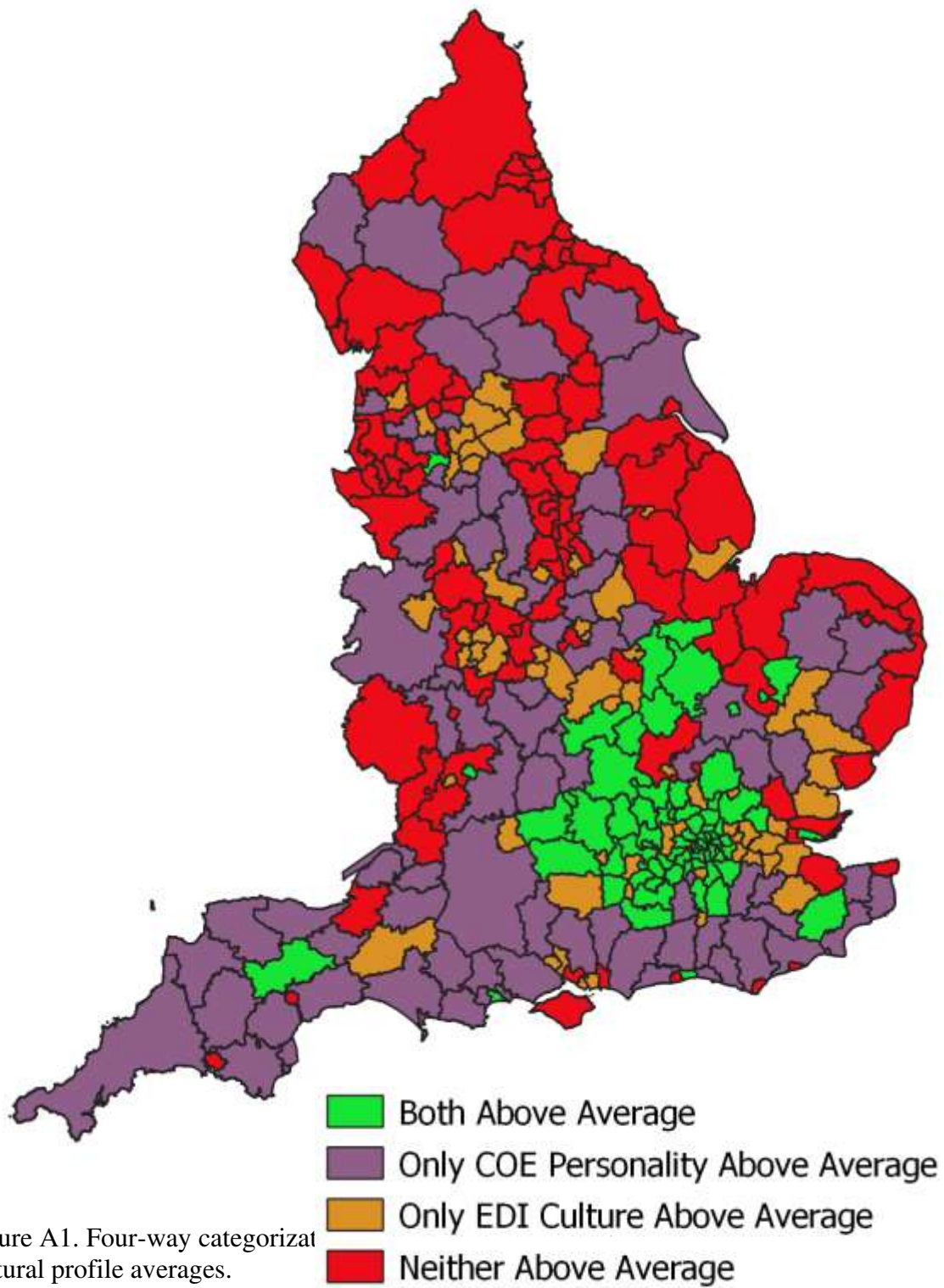


Figure A1. Four-way categorization of cultural profile averages.

**Table A1***Underlying Data for Measures of Community Culture*

Variable	Description and Source
Engagement with Employment and Education	<ul style="list-style-type: none"> <li>• Male economic activity rates from the 2010 Annual Population Survey (APS)</li> <li>• Inverse of the proportion of the population with no education 2010 (APS)</li> <li>• Days of absenteeism at primary and secondary schools in 2009 (Schools' Statistics).</li> </ul>
Social Cohesion	<ul style="list-style-type: none"> <li>• Measures of homogeneity in terms of ethnic similarity and religious similarity in 2011 (Census data).</li> <li>• Gross migration in 2010 (National Health Service Central Register)</li> <li>• Proportion of the population born abroad in 2010 (APS).</li> <li>• Proportion perceiving themselves to be of the nationality of the resident country (for example, English in English localities) (APS).</li> </ul>
Feminine and Caring	<ul style="list-style-type: none"> <li>• Female economic activity in 2010 (APS)</li> <li>• Proportion of female employment that is part time in 2010 (APS)</li> <li>• Proportion of population undertaking caring activities that are unpaid in 2011 (Census).</li> </ul>
Adherence to Social Rules	<ul style="list-style-type: none"> <li>• Age adjusted alcohol related deaths in the period 1998 to 2004 (Health Statistics Quarterly)</li> <li>• Younger age conceptions in 2009 (Health Statistics Quarterly)</li> <li>• Reported nonsexual violent crimes per capita in 2009 (Notifiable crimes recorded by the police).</li> <li>• Reported crimes by deception per capita in 2009 (Notifiable crimes recorded by the police).</li> </ul>
Collective Action	<ul style="list-style-type: none"> <li>• Trade union membership in 2010 (APS)</li> <li>• Proportion voting for parties with left of center leanings in 2010 (Electoral Commission)</li> </ul>

**Table A2***Descriptive Statistics*

	Mean	s.d.	Lower	Upper
GVA per Employee	5.48	1.27	3.62	11.30
COE Personality Profile	-7.31	0.98	-10.97	-4.13
EDI Culture Profile	-5.91	0.91	-7.75	-2.45
Cultural Heritage	87.38	96.77	2.46	606.19
Finance Employment	15.95	5.91	4.60	40.90
Manufacturing Employment	10.54	4.89	0.00	28.90
Population Density	1674.81	2365.15	24.40	13468.08
Industrial Diversification	0.71	0.05	0.56	0.84
Industrial Specialization	0.29	0.10	0.09	0.72
Major Airport	0.51	0.50	0.00	1.00
Port	0.58	0.49	0.00	1.00
Rail Connections	32.07	56.97	0.00	617.13
Institutions	-1.95	0.92	-4.73	0.00

**Table A3**

*Regressions of Local Gross Business Creation per Head in 2017 on Personality Psychology and Community Culture Profiles*

	Model 1	Model 2	Model 3	Model 4
COE Personality Profile	4.5110 (0.000)	3.3587 (0.007)	4.9566 (0.000)	4.0091 (0.001)
EDI Culture Profile	5.5036 (0.002)	6.5962 (0.000)	5.4173 (0.003)	7.1382 (0.000)
Cultural Heritage	0.0203 (0.094)	0.0219 (0.066)	0.0088 (0.515)	0.0628 (0.000)
COE Personality Profile*		3.6438		
EDI Cultural Profile		(0.000)		
COE Personality Profile*			0.0202	
Cultural Heritage			(0.065)	
EDI Cultural Profile*				0.0789
Cultural Heritage				(0.000)
Manufacturing Employment	-0.0847 (0.754)	-0.2477 (0.356)	-0.0850 (0.752)	-0.4998 (0.061)
Finance Employment	1.1009 (0.000)	0.9829 (0.000)	1.1296 (0.000)	0.8811 (0.000)
Population Density	10.7703 (0.127)	-0.2417 (0.974)	10.0855 (0.152)	14.8817 (0.028)
Industrial Diversification	69.6276 (0.007)	71.6452 (0.005)	72.1126 (0.005)	83.2188 (0.001)
Industrial Specialization	7.3061 (0.486)	6.7260 (0.513)	8.3110 (0.427)	17.2669 (0.088)
Major Airport	2.8988 (0.169)	3.8076 (0.068)	2.7988 (0.183)	4.5538 (0.025)
Port	0.1596 (0.946)	0.7420 (0.748)	0.0383 (0.987)	0.6563 (0.768)
Rail Connections	0.2025 (0.000)	0.1795 (0.000)	0.1991 (0.000)	0.1671 (0.000)
Institutions	-1.6582 (0.754)	-1.2528 (0.809)	-1.2599 (0.811)	-1.4884 (0.767)
Constant	-26.7344 (0.149)	-23.2025 (0.202)	-29.6005 (0.110)	-30.8522 (0.080)
Regional NUTS 1 Dummies	Yes	Yes	Yes	Yes
<i>N</i>	324	324	324	324
<i>R</i> <sup>2</sup>	0.706	0.718	0.709	0.735
<i>F</i> -test	36.3 (0.000)	36.6 (0.000)	35.0 (0.000)	40.0 (0.000)

*p*-values in parentheses



**Table A4**

*Regressions of Local Net Business Creation per Head in 2017 on Personality Psychology and Community Culture Profiles*

	Model 1	Model 2	Model 3	Model 4
COE Personality Profile	0.6930 (0.152)	0.2775 (0.572)	0.8379 (0.089)	0.5134 (0.269)
EDI Culture Profile	2.4263 (0.001)	2.8202 (0.000)	2.3982 (0.001)	3.0113 (0.000)
Cultural Heritage	0.0022 (0.645)	0.0028 (0.554)	-0.0015 (0.775)	0.0174 (0.001)
COE Personality Profile*		1.3138		
EDI Cultural Profile		(0.001)		
COE Personality Profile*			0.0066	
Cultural Heritage			(0.128)	
EDI Cultural Profile*				0.0282
Cultural Heritage				(0.000)
Manufacturing Employment	-0.0741 (0.486)	-0.1328 (0.211)	-0.0741 (0.485)	-0.2226 (0.036)
Finance Employment	0.2272 (0.008)	0.1847 (0.029)	0.2365 (0.006)	0.1486 (0.073)
Population Density	12.4554 (0.000)	8.4847 (0.005)	12.2327 (0.000)	13.9267 (0.000)
Industrial Diversification	38.5184 (0.000)	39.2459 (0.000)	39.3264 (0.000)	43.3825 (0.000)
Industrial Specialization	4.8415 (0.241)	4.6323 (0.255)	5.1682 (0.211)	8.4062 (0.037)
Major Airport	1.4186 (0.088)	1.7463 (0.034)	1.3861 (0.095)	2.0109 (0.013)
Port	-0.4661 (0.614)	-0.2561 (0.779)	-0.5056 (0.584)	-0.2884 (0.745)
Rail Connections	0.0671 (0.000)	0.0588 (0.000)	0.0660 (0.000)	0.0545 (0.000)
Institutions	0.0177 (0.993)	0.1639 (0.936)	0.1472 (0.944)	0.0784 (0.969)
Constant	-26.2520 (0.000)	-24.9785 (0.001)	-27.1839 (0.000)	-27.7257 (0.000)
Regional NUTS 1 Dummies	Yes	Yes	Yes	Yes
<i>N</i>	324	324	324	324
<i>R</i> <sup>2</sup>	0.710	0.720	0.712	0.734
<i>F</i> -test	37.0 (0.000)	36.9 (0.000)	35.5 (0.000)	39.7 (0.000)

*p*-values in parentheses

**Table A5**

*Regression of Individual Level Income on Individual COE Personality Profile, Area Level EDI Culture Profile and Area Level Cultural Heritage*

	Model 1	Model 2	Model 3	Model 4
COE Personality Profile	3215.7 (0.000)	3217.2 (0.000)	3215.9 (0.000)	3215.7 (0.000)
EDI Culture Profile	1893.2 (0.000)	1904.3 (0.000)	1893.6 (0.000)	2024.9 (0.000)
Cultural Heritage	-0.1 (0.965)	-0.1 (0.962)	-0.1 (0.960)	3.3 (0.234)
COE Personality* EDI Culture		244.9 (0.000)		
COE Personality* Cultural Heritage			0.6 (0.280)	
EDI Culture* Cultural Heritage				4.8 (0.077)
Age	566.3 (0.000)	566.4 (0.000)	566.2 (0.000)	566.3 (0.000)
Age <sup>2</sup>	-38.9 (0.000)	-38.9 (0.000)	-38.9 (0.000)	-38.9 (0.000)
Male	6772.3 (0.000)	6777.9 (0.000)	6771.7 (0.000)	6772.0 (0.000)
White	2927.0 (0.000)	2925.9 (0.000)	2926.1 (0.000)	2924.6 (0.000)
No Formal Education	-11905.5 (0.000)	-11905.9 (0.000)	-11906.2 (0.000)	-11906.8 (0.000)
General Certificate of Secondary Education (GCSE) Equivalent	-7249.1 (0.000)	-7252.8 (0.000)	-7249.1 (0.000)	-7249.2 (0.000)
Vocational Course	-4856.2 (0.000)	-4863.5 (0.000)	-4855.1 (0.000)	-4856.6 (0.000)
Undergraduate Degree	4634.1 (0.000)	4634.8 (0.000)	4633.8 (0.000)	4634.8 (0.000)
Postgraduate Degree	8119.9 (0.000)	8119.7 (0.000)	8119.7 (0.000)	8119.9 (0.000)
Manufacturing Employment	-107.3 (0.039)	-108.2 (0.037)	-107.3 (0.039)	-134.5 (0.013)
Finance Employment	487.7 (0.000)	486.8 (0.000)	487.8 (0.000)	473.1 (0.000)
Population Density	-10799.2 (0.000)	-10880.3 (0.000)	-10799.6 (0.000)	-10340.3 (0.000)
Industrial Diversification	-663.6 (0.894)	-641.3 (0.898)	-666.4 (0.894)	353.6 (0.944)
Industrial Specialization	4195.1 (0.043)	4202.6 (0.042)	4195.7 (0.043)	4668.8 (0.025)
Major Airport	2160.6 (0.000)	2163.0 (0.000)	2160.2 (0.000)	2240.2 (0.000)
Port	-677.6 (0.075)	-676.0 (0.076)	-677.6 (0.075)	-638.4 (0.093)

Note: *p*-values in parentheses

**Table A5***Continued*

	Model 1	Model 2	Model 3	Model 4
Rail Connections	0.6 (0.885)	0.4 (0.915)	0.5 (0.887)	-1.5 (0.702)
Institutions	547.1 (0.008)	546.5 (0.008)	547.3 (0.008)	533.3 (0.010)
Constant	30948.1 (0.000)	30963.4 (0.000)	30949.7 (0.000)	30669.7 (0.000)
Areas	324	324	324	324
<i>N</i>	231,490	231,490	231,490	231,490

Note: *p*-values in parentheses

**Table A6**

*Logit Regression of Individual Level Self-Employment on Individual COE Personality Profile, Area Level EDI Cultural Profile and Area Level Cultural Heritage*

	Model 1	Model 2	Model 3	Model 4
COE Personality Profile	0.2652 (0.000)	0.2650 (0.000)	0.2666 (0.000)	0.2652 (0.000)
EDI Cultural Profile	0.0238 (0.240)	0.0203 (0.318)	0.0237 (0.242)	0.0217 (0.301)
Cultural Heritage	0.0017 (0.000)	0.0017 (0.000)	0.0018 (0.000)	0.0017 (0.000)
COE Personality* EDI Culture		0.0155 (0.028)		
COE Personality* Cultural Heritage			-0.0001 (0.040)	
EDI Culture* Cultural Heritage				-0.0001 (0.694)
Age	0.0531 (0.000)	0.0531 (0.000)	0.0531 (0.000)	0.0531 (0.000)
Age <sup>2</sup>	-0.0024 (0.000)	-0.0024 (0.000)	-0.0024 (0.000)	-0.0024 (0.000)
Male	0.6544 (0.000)	0.6549 (0.000)	0.6546 (0.000)	0.6544 (0.000)
White	-0.0831 (0.000)	-0.0833 (0.000)	-0.0827 (0.000)	-0.0830 (0.000)
No Formal Education	0.0640 (0.078)	0.0641 (0.077)	0.0642 (0.077)	0.0640 (0.078)
GCSE Equivalent	-0.0334 (0.156)	-0.0334 (0.155)	-0.0334 (0.156)	-0.0334 (0.156)
Vocational Course	0.0980 (0.001)	0.0977 (0.001)	0.0976 (0.001)	0.0980 (0.001)
Undergraduate Degree	0.0236 (0.269)	0.0237 (0.267)	0.0236 (0.269)	0.0235 (0.270)
Postgraduate Degree	-0.1054 (0.000)	-0.1056 (0.000)	-0.1055 (0.000)	-0.1054 (0.000)
Manufacturing Employment	-0.0062 (0.095)	-0.0062 (0.093)	-0.0062 (0.094)	-0.0058 (0.132)
Finance Employment	0.0086 (0.002)	0.0086 (0.002)	0.0086 (0.002)	0.0089 (0.002)
Population Density	0.1082 (0.174)	0.1034 (0.194)	0.1078 (0.175)	0.1016 (0.211)
Industrial Diversification	-0.4057 (0.248)	-0.4062 (0.248)	-0.4061 (0.248)	-0.4197 (0.235)
Industrial Specialization	0.1018 (0.490)	0.1015 (0.491)	0.1014 (0.491)	0.0957 (0.518)
Major Airport	0.0242 (0.355)	0.0242 (0.354)	0.0241 (0.356)	0.0229 (0.384)
Port	0.0569 (0.030)	0.0569 (0.030)	0.0568 (0.030)	0.0561 (0.033)

Note: *p*-values in parentheses

**Table A6***Continued*

	Model 1	Model 2	Model 3	Model 4
Rail Connections	0.0000 (0.934)	0.0000 (0.952)	0.0000 (0.924)	0.0000 (0.845)
Institutions	0.0176 (0.207)	0.0175 (0.208)	0.0176 (0.207)	0.0178 (0.200)
Constant	-2.2336 (0.000)	-2.2316 (0.000)	-2.2337 (0.000)	-2.2305 (0.000)
Areas	324	324	324	324
<i>N</i>	272,292	272,292	272,292	272,292

Note: *p*-values in parentheses

**Table A7**

*Instrumental Variables Regressions of Local Gross Value Added per Employee in 2017 on Personality Psychology and Community Culture Profile instrumented by Cultural Heritage and Distance from Coal Deposits*

	1 <sup>st</sup> Stage COE- Personality Profile	1 <sup>st</sup> Stage EDI Cultural Profile	Productivity
COE Personality Profile			-0.1920 (0.191)
EDI Cultural Profile			1.1234 (0.000)
Cultural Heritage	0.0049 (0.000)	-0.0008 (0.025)	
Distance from Coalfield	0.0310 (0.213)	0.1628 (0.000)	
Manufacturing Employment	-0.0074 (0.551)	0.0193 (0.035)	-0.0435 (0.022)
Finance Employment	0.0490 (0.000)	0.0138 (0.050)	0.0633 (0.000)
Population Density	0.6327 (0.010)	2.1285 (0.000)	-2.3541 (0.000)
Industrial Diversification	-3.5616 (0.003)	-0.2625 (0.769)	5.6372 (0.002)
Industrial Specialization	0.1010 (0.836)	-0.2734 (0.452)	2.8050 (0.000)
Major Airport	0.3778 (0.000)	0.2204 (0.001)	0.2247 (0.095)
Port	-0.0241 (0.794)	-0.3562 (0.000)	0.1994 (0.166)
Rail Connections	0.0006 (0.512)	0.0017 (0.016)	0.0015 (0.303)
Institutions	0.2476 (0.213)	0.0707 (0.632)	-0.1638 (0.589)
Constant	1.4253 (0.107)	-0.8858 (0.177)	0.2060 (0.875)
Regional NUTS 1 Dummies	No	No	No
<i>N</i>	310	310	310
<i>R</i> <sup>2</sup>			0.335
<i>F</i> -test			17.5 (0.000)

Note: *p*-values in parentheses

**Table A8**

*Regressions of Local Gross Value Added per Employee in 2017 on Personality Psychology and Community Culture Profiles with Spatial Lags*

	Direct Effect	Spatial Lag	Indirect Effect	Total Effect
COE Personality Profile	0.1029 (0.173)	1.9045 (0.038)	1.5553 (0.038)	1.6582 (0.027)
EDI Cultural Profile	0.2252 (0.037)	-0.3029 (0.728)	-0.2474 (0.728)	-0.0222 (0.975)
Cultural Heritage	-0.0024 (0.002)	-0.0255 (0.023)	-0.0208 (0.023)	-0.0232 (0.010)
Manufacturing Employment	-0.0046 (0.774)			
Finance Employment	0.0314 (0.018)			
Population Density	-1.2887 (0.002)			
Industrial Diversification	6.4975 (0.000)			
Industrial Specialization	1.9533 (0.002)			
Major Airport	-0.0575 (0.672)			
Port	-0.2958 (0.036)			
Rail Connections	0.0013 (0.279)			
Institutions	-0.5021 (0.109)			
Constant	0.2762 (0.802)			
Regional NUTS 1 Dummies	Yes			
<i>N</i>	310			
<i>R</i> <sup>2</sup>	0.550			
Wald-test	379.4 [23] (0.000)			

Notes: *p*-values in parentheses; degrees of freedom in squared brackets

**Table A9**

*Regressions of Local Gross Value Added per Employee in 2017 on Personality Traits and Community Culture Profiles*

	Model 1	Model 2	Model 3
Extraversion	5.0054 (0.000)	4.7282 (0.001)	4.9863 (0.000)
EDI Cultural Profile	0.2916 (0.009)	0.3305 (0.003)	0.2882 (0.010)
Cultural Heritage	-0.0022 (0.002)	-0.0024 (0.001)	-0.0023 (0.002)
Extraversion * EDI Cultural Profile		2.6853 (0.028)	
Extraversion * Cultural Heritage			0.0085 (0.477)
Agreeableness	-0.4100 (0.851)	-0.5387 (0.805)	-0.3530 (0.871)
EDI Cultural Profile	0.3271 (0.005)	0.3352 (0.004)	0.3378 (0.004)
Cultural Heritage	-0.0016 (0.023)	-0.0019 (0.011)	-0.0013 (0.089)
Agreeableness * EDI Cultural Profile		-2.6141 (0.193)	
Agreeableness * Cultural Heritage			-0.0212 (0.318)
Conscientiousness	0.9464 (0.498)	0.9555 (0.498)	0.8414 (0.548)
EDI Cultural Profile	0.3451 (0.003)	0.3463 (0.004)	0.3584 (0.002)
Cultural Heritage	-0.0017 (0.020)	-0.0017 (0.029)	-0.0010 (0.268)
Conscientiousness * EDI Cultural Profile		0.0684 (0.957)	
Conscientiousness * Cultural Heritage			-0.0162 (0.285)
Neuroticism	-3.9179 (0.007)	-3.7504 (0.009)	-3.8825 (0.008)
EDI Cultural Profile	0.2983 (0.009)	0.3215 (0.004)	0.2999 (0.009)
Cultural Heritage	-0.0021 (0.004)	-0.0019 (0.010)	-0.0021 (0.013)
Neuroticism* EDI Cultural Profile		-3.6745 (0.013)	
Neuroticism * Cultural Heritage			0.0023 (0.878)

Note: *p*-values in parentheses



**Table A9***Continued*

	Model 1	Model 2	Model 3
Openness	-1.5844 (0.203)	-2.1942 (0.090)	-1.3464 (0.293)
EDI Cultural Profile	0.3228 (0.005)	0.3268 (0.004)	0.3321 (0.004)
Cultural Heritage	-0.0011 (0.193)	-0.0011 (0.165)	-0.0012 (0.154)
Openness* EDI Cultural Profile		1.4526 (0.095)	
Openness * Cultural Heritage			0.0092 (0.431)

Note: *p*-values in parentheses

**Table A10***Correlation Matrix for Individual Personality Traits and Cultural Dimensions*

	1. GVA per Employee	2	3	4	5	6	7	8	9	10	11	12
2. COE Personality Profile	0.392 (0.000)											
3. EDI Cultural Profile	0.516 (0.000)	0.363 (0.000)										
4. Engagement with Education and Employment	0.117 (0.040)	0.003 (0.958)	-0.092 (0.104)									
5. Social Cohesion	-0.473 (0.000)	-0.414 (0.000)	-0.888 (0.000)	0.314 (0.000)								
6. Feminine and Caring Activities	-0.359 (0.000)	-0.203 (0.000)	-0.813 (0.000)	0.349 (0.000)	0.724 (0.000)							
7. Adherence to Social Rules	-0.094 (0.098)	0.044 (0.437)	-0.597 (0.000)	0.516 (0.000)	0.569 (0.000)	0.589 (0.000)						
8. Collective Actions	-0.276 (0.000)	-0.359 (0.000)	-0.202 (0.000)	-0.295 (0.000)	0.065 (0.252)	-0.156 (0.006)	-0.435 (0.000)					
9. Extraversion	0.442 (0.000)	0.811 (0.000)	0.403 (0.000)	-0.039 (0.494)	-0.427 (0.000)	-0.318 (0.000)	-0.117 (0.039)	-0.158 (0.005)				
10. Agreeableness	-0.262 (0.000)	-0.260 (0.000)	-0.499 (0.000)	0.256 (0.000)	0.526 (0.000)	0.487 (0.000)	0.449 (0.000)	-0.104 (0.066)	-0.259 (0.000)			
11. Conscientiousness	-0.102 (0.074)	0.099 (0.083)	-0.417 (0.000)	0.482 (0.000)	0.528 (0.000)	0.553 (0.000)	0.662 (0.000)	-0.500 (0.000)	-0.138 (0.015)	0.600 (0.000)		
12. Neuroticism	-0.293 (0.000)	-0.696 (0.000)	-0.088 (0.120)	-0.222 (0.000)	0.073 (0.202)	-0.057 (0.318)	-0.320 (0.000)	0.441 (0.000)	-0.495 (0.000)	-0.217 (0.000)	-0.390 (0.000)	
13. Openness	0.204 (0.000)	0.674 (0.000)	0.445 (0.000)	-0.369 (0.000)	-0.610 (0.000)	-0.411 (0.000)	-0.354 (0.000)	0.060 (0.295)	0.501 (0.000)	-0.469 (0.000)	-0.479 (0.000)	-0.121 (0.033)

Note: p-values in parentheses

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