University of Groningen

The relevance of personality traits for urban economic growth

Garretsen, Harry; Stoker, Janka I.; Soudis, Dimitrios; Martin, Ron; Rentfrow, Jason

Published in:
Journal of Economic Geography

DOI:
[10.1093/jeg/lby025](https://doi.org/10.1093/jeg/lby025)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2019

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Garretsen, H., Stoker, J. I., Soudis, D., Martin, R., & Rentfrow, J. (2019). The relevance of personality traits for urban economic growth: making space for psychological factors. *Journal of Economic Geography*, 19(3), 541-565. <https://doi.org/10.1093/jeg/lby025>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

The relevance of personality traits for urban economic growth: making space for psychological factors

*Harry Garretsen**, *Janka I. Stoker**, *Dimitrios Soudis**, *Ron Martin**,[†]* and *Jason Rentfrow****

*Faculty of Economics and Business, University of Groningen, PO Box 800, 9700 AV Groningen, The Netherlands

**Department of Geography, University of Cambridge, Downing Place, Cambridge CB2 3EN, UK

***Department of Psychology, University of Cambridge, Downing Street, Cambridge CB2 3EB, UK

[†]Correspondence to: email <rlm1@cam.ac.uk>

Abstract

Economic growth differences across regions and cities can only be partly explained by standard explanations in economic geography. One reason for this might be the neglect of the psychological make-up of cities and its citizens. To assess the value added of incorporating psychological factors alongside the more standard explanations, this paper tests the relevance of personality traits for economic growth for a sample of UK cities. We argue that Neuroticism and Conscientiousness, and the traits that make up entrepreneurship culture help to explain urban growth differences. The personality scores of >400,000 UK residents are combined with economic data for 63 UK cities from 1981 to 2011. We find that both Neuroticism and entrepreneurship culture matter for economic growth. Our main contribution is that geographically clustered personality traits help to understand economic growth differences, and add explanatory power over and above standard determinants, also when the recursive relationship between personality traits and economic growth is taken into account.

Keywords: Personality traits, psychology, economic geography, UK cities

JEL classifications: R10, R12

Date submitted: 2 May 2017 **Editorial decision:** 21 April 2018 **Date accepted:** 3 May 2018

1. Introduction

The field of economic geography centers around the age-old question as to what explains the uneven spatial growth and distribution of economic activity (Garretsen and Martin, 2010, 2011). To answer this question, there is no shortage of theories and explanations, and empirical research on the causes and consequences of regional or urban differences has delivered useful insights (for an overview and assessment see Martin, 2016). At the same time, it is also obvious that our explanations are far from complete. In the case of UK cities, for instance, Martin et al. (2016a) recently showed that the divergent city growth trajectories that have characterised that country over the past 40 years can only be partly explained using the standard variables, like the degree

of specialisation, agglomeration economies, the degree of competitiveness, or the skills composition. They conclude that most of the between-city growth variation seems to be accounted for by other, as yet undetermined, ‘city-specific’ or local effects (see also Gardiner et al., 2013).

To understand what might drive these local effects and their impact on urban and regional growth, Martin and Sunley (2015) suggest that it could be instructive to explore the role of psychological factors. This is in essence a call for more *agency*, that is to say more attention to the relevance of the characteristics of individual agents as drivers of local outcomes (Martin and Sunley, 2015; Huggins and Thompson, 2016, 2019; Lee, 2017). The call for more agency in economic geography is, of course, not new. The importance of local culture and other ‘soft’ intangible factors as determinants of economic growth have been recognised for some time now (see Rodríguez-Pose and Storper, 2006). But there has been less attention paid to the role of individual characteristics of agents and how the spatial clustering of individual characteristics or traits can inform our understanding of urban and regional economic differences. This is about to change thanks to recent research on ‘geographical psychology’ (Rentfrow et al., 2008, 2015). The findings that emerge from this research reveal robust regional differences in personality traits, as well as strong associations between these personality differences and a range of local social–economic indicators (Rentfrow, 2013, 2015). In this emerging literature, the personality traits are measured by the so-called Big Five personality traits, namely Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism, which are the commonly accepted dimensions to measure personality (for an overview see John et al., 2008).

When it comes to the possible relevance of personality traits to understand urban and regional economic growth differences, it has been suggested that these traits, as measured by the Big Five, are relevant for local economic growth and outcomes via their impact on local entrepreneurial activity (Obschonka et al., 2013, 2015). Typically, in psychological research these traits are studied in two ways, a *variable-oriented* and a *person-oriented* approach whereby the former focuses on single personality traits, whereas the latter refers to the overall combination of traits that characterise an individual (Magnusson and Torestad, 1993). As we will argue below, we will take both approaches into account by showing whether and how individual personality traits, as well as so-called ‘entrepreneurship culture’ (e.g., Stuetzer et al., 2018) which combines traits, help to explain urban growth differences across the UK.

Our central aim in this paper is to investigate the relevance of personality traits for long-term economic growth over and above the standard correlates that have been offered by the literature so far. We do so by using the unique data set from Rentfrow et al. (2015) which consists of the Big Five personality scores of >400,000 UK residents, and combine these data with a detailed economic data set for 63 UK cities ranging from 1981 to 2011 constructed by Martin et al. (2014). This is not the first paper to link data on personality traits to local economic variables for the case of the UK (see Obschonka et al., 2015, 2016; Rentfrow et al., 2015; Lee, 2017), but it is the first to address the issue for individual UK cities. And, with the exception of Stuetzer et al. (2018) for the USA, our paper is the first to address the relevance of personality traits for economic growth and similarly for assessing the causality between personality traits and economic growth.

Our main finding is that both the Big Five personality trait Neuroticism and the overall combination of the Big Five traits that make for a city’s ‘entrepreneurship

culture' (see Lee, 2017; Stuetzer et al., 2018) matter for economic growth, and add explanatory power over and above more standard determinants of economic growth for UK cities. Our contribution to the literature on urban economic growth is that we provide theory-based empirical evidence that the psychological make-up of a place, as measured by the personality traits, is an important complementary factor in understanding the different growth trajectories of UK cities. In doing so, we also contribute to the emerging literature on personality traits and spatial differences by dealing with the issue of causality between personality traits and economic growth.

The paper is organised as follows. In the next section, we provide a theoretical background on the determinants of urban and regional growth as well as on the Big Five personality traits. The data set and the empirical model are introduced in Section 3. Section 4 presents the empirical results. Section 5 discusses the wider implications of our findings and concludes.

2. Geography and personality traits

2.1. Economic geography and the role of informal institutions

A vast literature in the field of economic geography is concerned with why economic outcomes vary across space (see e.g., Brakman et al., 2009; Storper, 2013; Martin, 2015). There is, however, no agreed consensus around a particular theory, but rather a proliferation of perspectives, concepts and empirical accounts. Nevertheless, a number of main factors have tended to be highlighted as being important for explaining the spatial variation in economic performance (in terms of per capita incomes, productivity, innovation, entrepreneurship and the like), namely: agglomeration, specialisation, proximity (in its different forms), connectivity (including production networks and supply chains) and institutions (Storper, 2013). Yet while these factors no doubt exert a significant influence, the residual or unexplained part in explaining in spatial economic differences is often substantial.

In the UK, for example, there are considerable spatial inequalities in economic growth and prosperity (Martin et al., 2014, 2016; Martin, 2015), but the standard set of factors referred to above at best only partially account for this uneven economic geography. For example, the case of London aside, neither size (as measured by population or employment) nor specialisation nor skills, fully explain the divergent pattern of economic growth across Britain's cities over recent decades. In fact, the evidence suggests that other, historically persistent, city-specific factors play a significant role (Martin et al., 2016a). However, what these factors are remains to be fully explored. In our view and following the recent literature on 'geographical psychology', a possible candidate for these city-specific factors are what psychologists call 'personality traits' and in particular how these traits are spatially clustered. It is the spatial clustering of these traits that may help to shape differences in local culture, local informal institutions and social capital which in turn exert an influence on economic growth. The idea that institutions matter for economic growth, be it at the national or regional level, is well-documented (North, 1994; Martin, 2000). This is also true for informal institutions.

In the regional context, Huggins and Thompson (2016) and Rodríguez-Pose and Storper (2006) show that local informal institutions in the guise of local social capital or local culture can shape regional and urban development and help to understand the

persistence of the spatial differences in these developments. Within this set of local informal institutions the role of entrepreneurship culture has been singled out as a key factor in explaining why informal institutions matter for economic growth (Beugelsdijk, 2007, 2004). Research also shows that individual measures for well-being are regionally clustered (Aslam and Corrado, 2012). Indeed, in the institutional approach to geography (Martin, 2000; Gertler, 2010), the central idea is that regions or cities, via their citizens, develop certain location-specific formal as well as informal institutional features over time that in turn can lead to (persistent) spatial differences in economic behaviours and outcomes. When it comes to the role of local entrepreneurship culture, a key question is then how such a (historically shaped) culture can be linked to the personalities of the local people, because it is ultimately the people who determine the nature of an entrepreneurship culture. Obschonka et al. (2015) and Stuetzer et al. (2016, 2018) show how entrepreneurship culture can be seen as the result of the (local clustering) of personality traits of individuals. The question then becomes how these traits can be measured, which is the topic to which we turn next.

2.2. The Big Five personality traits

Within the field of psychology, research into geographical variations in personality traits dates back to the mid-20th century, when researchers attempted to understand and provide explanations for the anti-Semitism displayed before and during World War II. This work spawned several theories about the nature of national differences in personality (e.g., Lewin, 1936; Adorno et al., 1950), which provided a basis for research on cultural differences. But with no unifying framework for conceptualizing and measuring personality, national comparisons of personality were difficult to interpret and, arguably, unreliable. Consequently, interest in personality and ‘national character’ faded from view in psychology from the 1960s onwards.

However, in the 1990s, a suitable conceptual and empirical framework for classifying and measuring personality emerged and began to garner scientific consensus. Factor analyses of trait ratings made by hundreds of thousands of participants provided evidence for the existence of five broad personality dimensions that can be reliably measured and used to predict behaviour in multiple situations (e.g., John and Srivastava, 1999; McCrae and Costa, 1999). These so-called ‘Big Five’ personality dimensions spell the acronym OCEAN: Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism. Openness (or Openness to Experience) is associated with traits like being curious and broad-minded; Conscientiousness includes aspects like being responsible and organised; Extraversion is associated with traits like being assertive and active; Agreeableness includes characteristics like being cooperative and tolerant and Neuroticism is associated with traits such as being anxious and depressed (Barrick and Mount, 1991). Table A1 in the *Appendix* lists the Big Five dimensions with all the items that correspond to each (John and Srivastava, 1999). Note that even though the Big Five personality traits are most widely used and confirmed personality traits in the literature, they are not without criticism, such as that they exclude some of the ‘darker’ psychological traits (Klotz and Neubaum, 2015; Miller, 2015).

The establishment of the Big Five led to a renewed interest among psychologists in geographical variations in personality. Indeed, over the past decade numerous studies have examined national differences in personality using the Big Five model. Results from these studies have revealed national and cultural differences in each of the Big

Five traits (e.g., Allik and McCrae, 2004; McCrae and Terracciano, 2008). For example, compared with other cultures, members of Asian cultures score low in Extraversion; members of Central and South American cultures score high in Openness and members of Southern and Eastern Europe score high in Neuroticism.

While most research on geographical differences in personality has focused on national differences, increasing attention has been given to the idea that *regional* variations in personality might also exist within nations. For example, Rentfrow et al. (2008) used data from over a half-million US residents to examine statewide differences in personality. Analyses of the mean state-level personality scores suggested that Openness is highest among residents in New York, Massachusetts, Washington DC, as well as California, Oregon and Washington state and Neuroticism is highest among residents of the New England, Mid-Atlantic and Gulf Coast states (Rentfrow et al., 2008). There is also evidence for regional personality variation in Great Britain. Again, using the Big Five model, Rentfrow et al. (2015) examined regional personality differences across the 380 Local Authority Districts (LADs) across UK. The results once again revealed regional variation. For instance, compared with other regions in Great Britain, much of Wales and many districts in the English Midlands were high in Neuroticism and most of the larger metropolitan areas, including most of the London boroughs, Brighton, Bristol, Manchester and Glasgow, were high in Openness (Rentfrow et al., 2015).

Studies of spatial personality variation have also examined the association between personality and various political, economic and health indicators (e.g., Rentfrow et al., 2015). Consistently, the results indicate that average levels of personality traits within regions are associated with important regional level variables. Thus, in both the USA and Great Britain, spatial variation in Neuroticism is linked to a range of mortality indicators, such that rates of heart disease, cancer and diabetes are higher in regions where the average level of Neuroticism is high (Rentfrow et al., 2008, 2015; Obschonka et al., 2013). Additionally, high levels of Openness are associated with political liberalism, as evidenced by votes cast for political candidates (Garretsen et al., 2018), attitudes towards same-sex marriage and the prevalence of foreign-born residents (Rentfrow et al., 2015).

There are several mechanisms that can explain not only the clustering of personality traits but also the persistence of such clustering. As Rentfrow et al. (2015) argue, one of the mechanisms responsible for geographical clustering in personality traits is through long-standing local social traditions and norms that gradually shape personality traits over time. In fact, for the case of the English and Welsh regions, Stuetzer et al. (2016) show how variations in the local presence of coal-based industries during the Industrial Revolution are still strongly associated with today's local variation in (clustered) Big Five scores: the stronger the historical dominance of these industries, the lower the scores on Conscientiousness and Extraversion and the higher scores on Neuroticism tend to be. That is, the economic development of a locality may shape the social norms, cultures and personality traits of its population. Thus, for example, it was in many of the UK's original industrial areas that labourist (working class) traditions and cultures emerged, including the formation of trades unions and the early Labour Party. Once established these socio-cultural-political traditions and traits can survive for long periods, even after the original industries and working conditions and practices around which they first formed have disappeared. However, this is not to argue that such cultural traditions, and the personality traits associated with them, are immalleable:

over time, as economic conditions and cultural norms change, and new generations replace old, so too can regionally clustered personality traits.

Another mechanism that contributes to geographical clustering of personality is selective migration. Here, the idea is that people prefer to live in places that best satisfy or ‘match’ their psychological needs (Jokela et al., 2015). For example, people who are curious and crave for new experiences are drawn to environments that can provide such stimulation (such as major cities). A third and final mechanism that accounts for geographical clustering of personality is physical geography. This is of course more relevant for (large) countries that have a substantial degree of ecological and natural environment variation. Thus, in geographical areas with histories of high pathogen prevalence, personality traits associated with cautious and risk-averse behaviour, such as low Extraversion, high Conscientiousness and low Openness are common because such traits are more advantageous in dangerous environments (Schaller and Murray, 2008); and in countries with demanding climates and limited natural resources, residents display greater communal values compared with people who live in mild and fertile environments (Van de Vliert, 2013).

2.3. Big Five, clustering and economic performance

Having introduced the concept of the Big Five personality traits and the fact that these traits often tend to be spatially clustered, we return to the question raised in Section 2.1: do local personality traits influence economic outcomes. The discussion in Section 2.2 suggests that the Big Five personality traits can be a useful instrument to capture the impact of local informal institutions and cultures on such aspects of economic behaviour as for instance entrepreneurship or risk-taking. The research that studies the relationship between Big Five personality traits and economic outcomes is characterised by two approaches, a *variable-oriented* and a *person-oriented* approach (Magnusson and Torestad, 1993).

Taking the variable-oriented approach, a few studies have explored the relationship between individual Big Five personality traits and economic variables. This line of research shows for instance social–economic well-being in the USA and in Great Britain to be associated with higher region-level Openness and Extraversion (Rentfrow et al., 2015) as well as Conscientiousness (Obschonka et al., 2015; Huggins and Thompson, 2016; Lee, 2017). Results from studies in the USA, Great Britain, and Germany also suggest that regions with high levels of Openness and low levels of Neuroticism are more resilient to shocks compared with areas where Openness is lower (Obschonka et al., 2015, 2016a, 2016b). In a related study for the UK regions, Lee (2017) finds a positive impact of Conscientiousness on regional innovation. A comparable significant role for low Neuroticism has been shown for entrepreneurial activity in the USA (Obschonka et al., 2013). Interestingly, regional variations in the levels of individual Neuroticism scores have also been shown to be the result of past local economic specialisation, which connects to the point made above about the (two-way) relationship between economic conditions and personality traits. From the perspective of our paper, it is important to note that none of these papers deal with the possible relevance of clustered personality traits for economic growth.

The person-oriented approach to the Big Five personality traits takes as a starting point the proposition that a person is best characterised by a constellation of personality traits (Asendorpf, 2003). One of the most prominent examples of these

constellations is the construction of the higher-order factors stability and plasticity, where stability is the combination of Neuroticism, Agreeableness and Conscientiousness, and plasticity is the combination of Extraversion and Openness (Van der Linden et al., 2010). In the context of economic outcomes, the concept of ‘entrepreneurship culture’ has been introduced as a way to analyse the role of Big Five personality traits. Entrepreneurship culture is identified with a personality structure of individuals characterised by high levels of Openness, Extraversion and Conscientiousness, and lower levels of Neuroticism and Agreeableness (Obschonka et al., 2013; see also Section 3.1). Research shows that such local entrepreneurship culture is a predictor of local economic resilience in the UK (Obschonka et al., 2016). With the exception of Stuetzer et al. (2018) for the case of the USA, this personality trait-based concept of entrepreneurship culture has not been used yet to explain economic growth.

Since the literature suggests that both a variable-oriented and a person-oriented approach of the Big Five can be useful, we will test whether both individual Big Five traits as well as their constellation via the concept of entrepreneurship culture appear to influence urban economic growth in the UK in our sample period. More specifically, for the variable-oriented approach there is solid evidence (Barrick et al., 2001; Zhao et al., 2010) on the role of personality for job performance. The evidence singles out two traits in particular, namely Conscientiousness and Neuroticism as being out important for job performance: ‘Indeed, it hard to conceive of a job, where it is beneficial to be careless, irresponsible, lazy, impulsive and low in achievement striving (low conscientiousness). (...) Similarly, being anxious, hostile, personally insecure and depressed (...) is unlikely to lead to high performance in any job’ (Barrick et al., 2001, p. 11). In economic terms, this translates into arguing that low Conscientiousness and high Neuroticism via their impact on job performance could lead to a lower level of labour productivity. To the extent that these two traits are spatially clustered, it would imply that cities or regions that score lower on Conscientiousness and/or higher on Neuroticism could well have lower productivity, and thence slower growth.

Following the person-oriented approach for the Big Five, we might expect, therefore, that local entrepreneurship culture will have a positive impact on local economic growth. The main reason is that a higher score on entrepreneurship culture signals that a location is likely to have more innovative activity (Stuetzer et al., 2018). This in turn translates into a higher economic growth because of the positive effects of innovation on total factor productivity in a city. Note that the channel via which traits impact on growth would be different for the variable-oriented approach and the person-oriented approach.

Before we present our data set and estimation results, it is important to stress that any relationship between local personality traits and local economic variables must recognise the likely two-way (recursive) relationship between local economic conditions and personality traits, discussed above (Section 2.2). To date, studies that relate the Big Five traits to all kinds of societal and economic outcomes have focused primarily on the relationship or association between the two without addressing this issue. But taking such ‘two-way causality’ (endogeneity) into account is obviously important. Also, selective migration might create a selection bias, because the observed geographical clustering of personality traits could also be the result of local social economic conditions attracting particular types of workers. With those traits it is well known for example that more ‘enterprising’ workers tend to have the highest migration rates. At

the same time, it has been documented that people who score higher on Extraversion, and Openness and lower on Agreeableness are more inclined to move to urban environments (Jokela et al., 2015; Rentfrow et al., 2015). In addition, and as another potential source for endogeneity, as we have argued, both individual personality traits and their observed geographical clustering can be thought of as being driven by previous social-economic conditions and development.¹ Obschonka et al. (2016), Lee (2017) and Stuetzer et al. (2018) all use an instrumental variable (IV) strategy to allow for such effects regarding their Big Five measures and economic outcomes. With the exception of Stuetzer et al. (2018), our paper is the first to employ an IV strategy to address endogeneity between personality and economic growth. We will do so in a novel way by exploiting the *individual* underlying data on which our Big Five data are based, as we will explain in more detail in Section 4.

3. Data and analysis

3.1. Data description

To investigate the potential relevance of clustered personality differences for urban economic growth, we combine two extensive data sets on economic data and personality data, respectively. The urban economic data come from Martin et al. (2014) (see also Martin et al., 2016a, 2016b). It comprises annual estimates of workplace employment and output (gross value added) across 46 sectors for 63 primary urban areas (PUAs) across the UK from 1981 to 2011.² PUAs are defined as ‘built-up’ areas based on contiguous LADs in and around cities. These PUAs account for about 60% of UK output and contain 70% of the country’s workforce. The reason to focus on a sample of PUAs is also that Martin et al. (2016a, 2016b) find that most of the between-city growth variation is driven by unspecified city-specific-fixed effects. We provide an

-
- 1 It is important to emphasise this point, since one of the referees to this paper charged us with implying ‘environmental determinism’ and ‘neoliberal individualisation of responsibility’ for uneven development, essentially the argument that slow local economic growth is ‘caused’ by certain personality traits—a sort of ‘blame the victim’ type of argument. We want to stress again that this critique is not valid, because what we are arguing is that personality traits may, to some extent and in complicated ways, be shaped by local economic circumstances (and history), and that in turn such traits may influence those same local economic conditions and their development; that is, for a recursive or two-way relationship between local economic context and local personality traits. Put another way, personality traits may themselves be *endogenous*, a product of the economic outcomes which they may, in turn, potentially influence. In a similar vein, it has often been argued by geographers that ‘culture’ has an important ‘conditioning’ influence on economic activity (indeed in some accounts it is a primary conditioning factor). In so far as personality and behavioural traits are themselves inextricably bound up with ‘culture’, then it seems reasonable to explore whether and to what degree personality traits might influence economic outcomes. To do this requires some way of controlling (allowing) for the dependence (endogeneity) of such personality traits on (previous) local economic outcomes: hence, our search for a suitable instrument in the modelling analysis reported below, in order to ascertain whether there is indeed any independent statistical relationship between personality traits and local economic outcomes. At no point do we interpret our findings below as indicating rigid, mechanistic causality; only whether any statistical evidence exists to suggest a possible influence.
 - 2 The economic data set is for a set of UK cities that includes Belfast City in Northern Ireland. Since our data on the personality traits are for regions and their people in Great Britain, our overall sample of cities and hence our empirical analysis only includes cities in Great Britain. For sake of brevity, we refer to our sample as ‘set of UK cities’.

overview of the 63 PUAs and their constitutive local district authorities in Table A1 in the *Appendix*. A full overview of the data construction process can be found in Martin et al. (2014).

The scores on the Big Five personality measures come from Rentfrow et al. (2015). Based on a survey of >400,000 residents across Great Britain that could be filled out online between 2009 and 2011, this data set provides information on personality attributes of individual participants across the 380 LADs in Great Britain. Answers on 44 Likert-type short statements were recorded for each participant and a principal components analysis was performed to extract the five underlying factors, namely, Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness. Analyses of the five scales revealed satisfactory internal reliability, with Cronbach's $\alpha = 0.86, 0.77, 0.83, 0.83$ and 0.79 , for Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness, respectively (Rentfrow et al., 2015) (for the full list of Big Five-related items see Table A1 in the *Appendix*). Scores are aggregated at the PUA level by averaging individual scores weighted by the number of survey participants in each of the LADs that make up the PUA. Following Stuetzner et al. (2018, see p. 5), the scores on the individual Big Five dimensions were used to create an entrepreneurial personality profile for each respondent.

Figure 1 shows the spatial variation in Neuroticism and Conscientiousness. Consistent with previous studies (e.g., Rentfrow et al., 2015; Lee, 2017), there is considerable variation among the PUA scores, in relative terms, while there is no overwhelming evidence of larger regional patterns, since adjacent PUAs sometimes score differently on the two variables. These findings are in line with those of Rentfrow et al. (2015) for all LAD districts. For Conscientiousness, the figure indicates lower scores for cities in Wales and Scotland, again in line with Rentfrow et al. (2015). In Figure 2, the entrepreneurship culture measure (see below for definition) for each PUA is depicted, showing that the south of the UK and in particular the London area score higher on entrepreneurship culture.

In addition to the personality traits, our data set also contains information for each individual respondent in the 400,000 sample on a host of additional variables like age, education (of respondents and their parents), local/non-local (i.e., whether or not the respondent grew up in the place of residence when the survey was filled out) and whether or not the respondent went through a specific traumatic youth experience (e.g., death of a parent). This last piece of information will be used to address the concerns about endogeneity that we mentioned above. Note again that the place of residence refers to the LAD level, which means that 'local' implies that the respondent grew up in the LAD district that is part of the PUA (see Table A2 of the *Appendix*). Based on these additional variables, it is possible to check for the representativeness of the sample, as has been done by Rentfrow et al. (2015). They compared the demographic characteristics of the LAD samples with LAD data from the 2011 UK Census. This comparison shows that the LAD samples were fairly representative of the local populations; for specific details, see Rentfrow et al. (2015).

3.2. The basic model

To test for the relevance of the Big Five personality scores, we estimate OLS and two-stage least squares (2SLS) models where the different dependent variables, to be introduced below, are regressed against the aggregated Big Five personality traits

Figure 1. Neuroticism and Conscientiousness by PUA.

(separately and via a composite measure of entrepreneurship culture) using a standard set of control variables for each PUA i ($i = 1 \dots 63$). As a first pass, these controls capture most of the standard explanations that have been brought forward to explain spatial economic disparities, as will be explained below.

The baseline model is:

$$Y_i = b_0 + b_1 \text{Psych}_i + \sum_j b_j X_{i,j} + \epsilon_i, \quad (1)$$

where Y_i represents the long-term average growth rates of employment and output for each PUA. We study the effect of Neuroticism, Conscientiousness and entrepreneurship culture on long-term performance by focusing on four long-term performance variables (where ‘long-term’ refers to our full sample period 1981–2011). We calculate the long-term average in employment and output growth, for each PUA, as well as their cumulative yearly deviation from national employment and output growth. The long-term average output or employment growth reflects the growth performance of each city in isolation. The cumulative growth differentials reflect that relative growth performance of each city versus the UK as a whole, which is of particular relevance to measuring the (increasing) growth divergence across the UK that motivates our analysis. Psych_i represents our personality measures for each PUA. The combination of Neuroticism and Conscientiousness, and entrepreneurship culture are regressed separately against the dependent variables, hence b_1 will thus be our main coefficient of interest.

$X_{i,j}$ is a vector that for each PUA gives the set of six control variables ($j = 2 \dots 7$) that will be used throughout our estimations. These are (i) the size of a city, (ii) a dummy coding whether a PUA is landlocked; (ii) kilometric distance to London; (iii) a dummy for New Town that codes cities and towns created after the New Towns Act 1946;

Figure 2. Entrepreneurship culture by PUA.

(iv) the Krugman specialisation index for each PUA; (v) the size of the city in terms of employment and (vi) the proportion of young people in the population. The choice for these six benchmark control variables is motivated by, on the one hand, existing theoretical and empirical work on the drivers of regional economic structure and performance (Brakman et al., 2009; Storper, 2013; Martin, 2016) and, on the other hand, the availability of data for UK cities. As to the former, we argued in Section 2.1 that five factors are commonly used to explain local and regional economic performance, namely agglomeration, specialisation, proximity, connectivity and institutions, and our control variables capture most of these factors in a simple manner, as described below. Table 1 gives the descriptive statistics for the variables introduced above.

3.3. Motivation of the control variables

The *size* of a PUA is meant to capture the existence of within-city agglomeration economies. The argument is that larger cities are characterised by stronger agglomeration economies partly because larger cities allow for a better matching and sharing of ideas (Duranton and Puga, 2004). Whether or not a city is *landlocked* is a simple way to approximate historical regional differences in trade Openness. As such it contains information on the positioning of the respective PUA in terms of international economic geography. When it comes to the internal or national economic geography of the UK, the *distance to London* is the variable to measure the physical (and economic) distance of a city to the UK's main economic centre, London. It is an approximation of the concept of market potential that is at the heart of (new) economic geography

Table 1. Descriptive statistics

Variables	N	Mean	Standard deviation	Min	Max
Avg. output growth	63	2.19	0.74	1.05	5.10
Avg. employment growth	63	0.51	0.63	−0.56	3.18
Cum. deviation from national output growth	63	−3.51	20.29	−37.60	82.02
Cum. deviation from national employment growth	63	−1.06	23.52	−37.90	91.96
Neuroticism	63	2.98	0.03	2.91	3.06
Conscientiousness	63	3.63	0.03	3.56	3.70
Entrepreneurship culture	63	−19.19	0.22	−19.65	−18.68
New town	63	0.09	0.29	0	1
Distance to London (log)	63	5.10	0.94	0	6.46
Size (log)	63	5.04	0.78	3.58	8.52
Landlocked	63	0.52	0.50	0	1
Krugman specialisation index	63	0.33	0.07	0.15	0.59
Young population (%)	63	0.56	0.05	0.45	0.69

literature (Brakman et al., 2009). It also captures the idea that connectivity between regions or cities matters. The inclusion of a *dummy for New Towns* is important because it is well-established (see Martin et al., 2014) that designated new and expanded towns like Milton Keynes or Telford, representing (post-WWII) planned cities, are different from cities that have a much longer history and which evolved more slowly over time and that are not the product of deliberate city planning by central government. In this sense, the inclusion of the new town dummy is an acknowledgement of the fact that governance arrangements and strategic planning matter. The *share of young people in a city's population* captures the idea that age composition matters for human capital and urban growth, where cities with a younger population are expected to perform better economically (Martin et al., 2016a). Finally, in urban and regional economics a standard determinant of economic performance is the specialisation structure (see, for example, Storper, 2013), here captured by the Krugman specialisation index (Martin et al., 2016a) across 46 sectors.

4. Estimation results

4.1. Neuroticism and Conscientiousness and long-term economic growth

To study the possible influence of Neuroticism and Conscientiousness on long-term economic growth, we focus on four outcome measures, where ‘long-term’ refers to our full sample period 1981–2011. The results are depicted in Table 2. Using the baseline model, only Neuroticism robustly correlates with these economic growth measures. For economy of space, in our additional analyses we do not present the results for Conscientiousness.³

3 Results are available upon request. Note that bootstrapping does not change our findings; again, the results are available upon request.

Table 2. Long-term economic growth and Neuroticism and Conscientiousness

	Dependent variable			
	Avg. output growth	Avg. employment growth	Cum. deviation from national output growth	Cum. deviation from national employment growth
Conscientiousness	3.066 (2.806)	2.692 (2.441)	98.402 (89.803)	86.423 (78.234)
Neuroticism	-4.652** (1.949)	-3.070* (1.741)	-148.340** (62.344)	-98.303* (55.720)
New town	1.275*** (0.327)	1.259*** (0.308)	40.909*** (10.457)	40.293*** (9.858)
Landlocked	0.204 (0.127)	0.122 (0.101)	6.505 (4.065)	3.939 (3.240)
Distance to London (log)	-0.133* (0.075)	-0.158** (0.065)	-4.255* (2.406)	-5.046** (2.067)
Krugman specialisation index	1.514 (1.322)	-0.143 (0.913)	48.446 (42.357)	-4.349 (29.218)
Size (log)	0.080 (0.100)	-0.082 (0.093)	2.596 (3.188)	-2.588 (2.987)
Young population (%)	1.406 (1.999)	2.600 (1.769)	44.805 (63.964)	83.179 (56.725)
Constant	3.701 (13.793)	-0.487 (11.275)	44.372 (441.476)	-36.558 (361.478)
Observations	63	63	63	63
Adjusted R^2	0.490	0.500	0.491	0.500

Robust standard errors in parentheses.

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

The average score for each PUA on Neuroticism is strongly negatively correlated with lower output growth, employment growth and the cumulative deviation from national output growth, but not cumulative deviation from national employment growth. A one standard deviation increase in Neuroticism is associated with 0.15% lower output growth or 0.10% lower employment growth, which translates into about 3.4% cumulative lower growth compared with the national average over the study period. To put this in perspective, if the PUA of Grimsby (the city with the highest score on Neuroticism) had an average Neuroticism score equal to that of Luton (the city with the lowest score on Neuroticism), other things being equal we would expect a 0.7% higher average yearly output growth or 22% smaller gap vis-a-vis national average output growth over the period. The only other variables that seem to have significant correlation with the outcome variables are distance to London, with the expected negative sign and the New Town dummy, with the expected positive sign.

These results are indicative of an influence of Neuroticism on city economic growth, but are potentially biased due to the possibility of reverse causality. Specifically, higher (lower) levels of economic growth could over time lead to lower (higher) levels of Neuroticism. This effect could materialise as people in terms of their personality traits are gradually influenced by the economic conditions in their locality. Since we are looking at economic conditions from 1981 onwards, this could have a bearing on local

traits as sampled some three decades later in 2011. Recall also that Obschonka et al. found that historical regional economic conditions, going back to the 19th century, have cast a long shadow over current (regionally clustered) personality traits. Similarly, as we discussed before, there could be a selection bias, in the sense that people with certain personality characteristics sort into certain regions based, *inter alia*, on the economic conditions in those regions.

To address this issue of potential endogeneity (Angrist et al., 1996), we undertook two additional analyses. First, as we discussed in Section 2.3, selective migration is not only one reason for the geographical clustering of the personality traits (Rentfrow et al., 2015) but also a reason to worry about possible reverse causality. Since we have information on whether or not the respondents grew up in the city that they lived in at the time of the Big Five survey, we can restrict our analyses to the group of local residents, and remove the respondents who had moved to a city at some previous point in time (see Stuetzer et al., 2018). The online Appendix to this paper shows the estimation results for long-term growth when we only include the Neuroticism scores for the locals of each PUA. As is clear from the table in the online Appendix, the relevance of Neuroticism for long-term growth holds when we only include the local population.

Second, as a more fundamental method of addressing endogeneity, we use a 2SLS approach (see also Lee, 2017). We use traumatic youth experience as an instrument for Neuroticism. Research shows that although personality traits are in general rather stable (Cobb-Clark and Schurer, 2012), they also can change throughout an individual's life span (Roberts et al., 2006), partly due to experiences in people's lives (Specht et al., 2011), and most strongly during childhood years (Twenge, 2000). These experiences can be related to the family environment or wider sociocultural conditions, and Neuroticism (or anxiety) can be affected by negative disruptions to those environments (Twenge, 2000).

In the BBC survey, respondents were asked whether they had a traumatic youth experience in the form of a death of a parent. This variable may not be strictly exogenous since poor economic conditions could be related to worse health and a lower life expectancy (Rentfrow et al., 2015), but research shows that, as opposed to socio-cultural conditions, economic conditions during childhood are not a driver of Neuroticism (Twenge, 2000). In addition, the survey further asked the participants how traumatic this experience was to them, *personally*, on a 1–7 scale. The answer to this question, being so individual-specific, would be generally uncorrelated with the economic condition of the region of the respondent.

As a check on the (ir)relevance of traumatic experience for Neuroticism and economic growth, Figure 3 shows the correlation between this Traumatic Experience indicator and the scores of Neuroticism, as well as output growth and employment growth. The upper left panel portrays a strong correlation between Neuroticism and Traumatic Experience ($p = 0.004$) supporting the relevance of the variable, while in the lower two panels no such correlation is visible between Traumatic Experience and output growth ($p = 0.659$) or employment growth ($p = 0.567$), supporting the claim of exogeneity. This result, combined with the theoretical argument set out by Twenge (2000), suggests that Traumatic Experience qualifies as a good instrument since it is significantly correlated with our personality trait of interest, Neuroticism, whereas it has no direct relationship with the dependent variable of interest, average output growth and average employment growth.

Figure 3. Two top panels show scatterplots of Neuroticism (on *y*-axis) and entrepreneurship culture and traumatic experience. Bottom panels show traumatic experience (on *y*-axis) and average output growth and average employment growth.

Given that the Traumatic Experience variable passes the minimum relevance criterion and exclusion criterion for a valid instrument, we estimate a 2SLS regression model. In the first stage, Neuroticism is predicted from Traumatic Experience and the control variables used in the previous section. Predicted Neuroticism is then used as the main independent variable in the second stage. The estimation results are presented in Table 3.

The second column depicts the results of the first-stage regression. Traumatic Experience is highly correlated to Neuroticism. The overall *F*-test is 11.32 and all relevant tests reject under-identification. In the following columns, the predicted Neuroticism from this first stage is used as an explanatory variable and is again highly significant, and now for all four long-term economic growth measures. In all four cases, Neuroticism has a clear negative relationship with output and employment growth. Using a Hausman test, the 2SLS estimates are not significantly different from their OLS counterparts given their high standard error.

4.2. Entrepreneurship culture and long-term economic growth

To study the effect of the Big Five personality traits on long-term performance, we use the composite measure of entrepreneurship culture, and the same four growth measures. Results are presented in Table 4.

As can be derived from Table 4, entrepreneurship culture is significantly positively correlated with both output and employment growth [the latter is in line with the findings from Stuetzner et al. (2018) for the USA], including the cumulative deviation from national output growth and national employment growth. To put this in perspective, if the PUA of Telford (the city with the lowest score on entrepreneurship culture) were to increase its entrepreneurship culture to the level of London, we would

Table 3. Long-term economic growth and Neuroticism; 2SLS results

	Dependent variable				
	Neuroticism (1st stage)	Avg. output growth	Avg. employment growth	Cum. deviation from national output growth	Cum. deviation from national employment growth
Traumatic experience	0.119*** (0.036)				
Neuroticism		−10.795** (4.887)	−9.546** (3.917)	−344.786** (156.280)	−305.619** (125.399)
New town	−0.024*** (0.009)	1.200*** (0.376)	1.175*** (0.344)	38.521*** (12.019)	37.598*** (11.003)
Landlocked	0.0003 (0.008)	0.268* (0.141)	0.184 (0.118)	8.548* (4.497)	5.920 (3.780)
Distance to London	0.007* (0.004)	−0.102 (0.093)	−0.122* (0.073)	−3.271 (2.971)	−3.878* (2.343)
Krugman specialisation index	0.094* (0.052)	1.953 (1.505)	0.326 (0.970)	62.483 (48.226)	10.644 (31.093)
Size (log)	0.001 (0.006)	0.073 (0.109)	−0.085 (0.095)	2.383 (3.489)	−2.704 (3.037)
Young population	0.068 (0.060)	0.201 (1.596)	1.549 (1.358)	6.137 (51.069)	49.421 (43.554)
Constant	2.331*** (0.167)	33.588** (14.129)	28.895** (11.366)	1001.497** (451.939)	905.057** (363.862)
Observations	63	63	63	63	63
Adjusted R^2		0.433	0.411	0.434	0.411

Notes: First-stage F -statistic/Kleibergen-Paap $F=11.07$ ($p=0.006$). Fifteen percent maximal IV size is rejected. Robust standard errors in parentheses.

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

expect a 0.9% higher average yearly output growth or 27% smaller gap vis-a-vis the national average output growth. The only other variables that seem to be significant predictors across the outcome variables are comparable to the results in Table 2.

As with the results for Neuroticism, we have to address the issue of reverse causality. Again, we first estimated the same model, but now only for locals. Results, as reported in the Online Appendix to this paper, show that entrepreneurship culture remains a significant predictor of all economic growth variables.

Second, we use a 2SLS approach again. Like with Neuroticism, we suggest that traumatic youth experience is also a good instrument for entrepreneurship culture. Based on recent research in the field of finance, it can be argued that early life events shape behaviours. More specifically, Bernile et al. (2017) show how childhood experiences with respect to natural disasters like earthquakes or floodings shape risk-taking behaviour later in adult life. Similarly, the work of Schoar and Zuo (2017) suggests that the macro-economic business cycle in early life affects risk-taking. Since risk-taking is generally conceived as a key characteristic of entrepreneurship (Stewart and Roth, 2001), we cast traumatic experience as a relevant instrument variable for entrepreneurship culture too.

Table 4. Long-term economic growth and entrepreneurship culture

	Dependent variable			
	Avg. output growth	Avg. employment growth	Cum. deviation from national output growth	Cum. deviation from national employment growth
Entrepreneurship culture	0.956*** (0.319)	0.718** (0.293)	30.610*** (10.186)	22.977** (9.371)
New town	1.379*** (0.330)	1.334*** (0.311)	44.228*** (10.564)	42.687*** (9.948)
Landlocked	0.225* (0.120)	0.145 (0.096)	7.191* (3.851)	4.650 (3.072)
Distance to London (log)	−0.107 (0.075)	−0.137** (0.061)	−3.408 (2.410)	−4.389** (1.964)
Krugman specialisation index	1.240 (1.270)	−0.320 (0.842)	39.700 (40.693)	−10.044 (26.973)
Size (log)	0.014 (0.096)	−0.133 (0.089)	0.479 (3.086)	−4.229 (2.867)
Young population (%)	0.264 (1.554)	1.587 (1.323)	8.149 (49.734)	50.659 (42.432)
Constant	20.199*** (6.199)	14.671*** (5.690)	575.352*** (198.208)	449.262** (182.146)
Observations	63	63	63	63
Adjusted R^2	0.518	0.527	0.520	0.527

Robust standard errors in parentheses.

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

As a check on the (ir)relevance of traumatic experience for entrepreneurship culture and economic growth, the upper right panel of Figure 3 above shows that the correlation between this Traumatic Experience measure and entrepreneurship culture is highly significant ($p = 0.001$), whereas the correlation between traumatic experience and output or employment growth is thus not significant. So both for Neuroticism and entrepreneurship culture, we think that Traumatic Experience variable makes sense as an instrument variable, both conceptually and statistically. The estimation results of our 2SLS regression model for entrepreneurship culture are presented in Table 5.

In the first stage, entrepreneurship culture is predicted from Traumatic Experience and the control variables used in the previous section. Predicted entrepreneurship culture is then used as the main independent variable in the second stage. In the following columns is again highly significant, and now for all four long-term economic growth measures. In all four cases, entrepreneurship culture has a clear positive relationship with output and employment growth.

5. General discussion and conclusions

Our central aim in this paper has been to investigate, for the case of UK cities, the relevance of personality traits for long-term economic growth over and above the

Table 5. Long-term economic growth and entrepreneurship culture; 2SLS results

	Dependent variable				
	Entrepreneurship culture (1st stage)	Avg. output growth	Avg. employment growth	Cum. deviation from national output growth	Cum. deviation from national employment growth
Traumatic experience	−0.797*** (0.205)				
Entrepreneurship culture		1.609** (0.715)	1.423*** (0.552)	46.688** (18.885)	40.292*** (14.130)
New town	0.055 (0.105)	1.374*** (0.352)	1.328*** (0.337)	29.135*** (8.027)	27.972*** (8.204)
Landlocked	0.018 (0.046)	0.236* (0.127)	0.156 (0.101)	4.671 (3.231)	4.111 (2.573)
Distance to London	−0.079*** (0.028)	−0.045 (0.100)	−0.071 (0.078)	2.349 (2.932)	−0.240 (2.078)
Krugman specialisation index	−0.234 (0.332)	1.317 (1.356)	−0.237 (0.922)	39.774 (41.930)	−5.915 (24.825)
Size (log)	0.048 (0.037)	−0.012 (0.102)	−0.161 (0.099)	−1.321 (2.596)	−5.671*** (2.184)
Young population (%)	−0.551 (0.446)	0.350 (1.681)	1.680 (1.448)	8.128 (42.125)	31.022 (35.098)
Constant	−14.939*** (0.983)	32.461** (13.513)	27.899*** (10.474)	867.765** (353.176)	782.163*** (264.992)
Observations	63	63	63	63	63
Adjusted R^2		0.485	0.475	0.305	0.337

Notes: First-stage F -statistic/Kleibergen-Paap $F = 15.12$ ($p = 0.006$). Fifteen percent maximal IV size is rejected. Robust standard errors in parentheses.

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

standard determinants that have been offered by the economic geography literature. In line with the institutional approach to geography (Martin, 2000; Gertler, 2010), the starting point for our analysis is that differences in local informal institutions, such as local social norms and culture, are important influences on the well-established different growth trajectories across the UK. Building on the recent literature on ‘geographical psychology’ (Rentfrow et al., 2008), our primary and novel contribution is that we argue and test that spatially clustered personality traits can be seen as relevant building blocks of local informal institutions and hence as influences on local economic growth. In this respect, our paper provides empirical support for the suggested theoretical framework by Huggins and Thompson (2019) where they link personality traits via agency to urban and regional development.

Following the literature on the relationship between personality traits and job performance (Barrick et al., 2001), we expected that the regionally clustered personality traits Neuroticism and Conscientiousness might matter for economic growth through their impact on job performance. Also, following previous work from Obschonka et al. (2013) and Stuetzer et al. (2018), we postulated that the concept of entrepreneurship culture (which is a constellation of all Big Five personality traits) would positively relate to urban economic growth.

Our first main contribution, combining the data on the Big Five personality traits from Rentfrow et al. (2015) and the economic data on UK cities from Martin et al. (2014), is that we find that spatially clustered personality traits appear to matter for urban economic growth. More specifically, we find that the individual trait of Neuroticism, and the constellation of personality traits, as summarised by the concept of entrepreneurship culture, both matter for economic growth. Results indicate that UK cities (as defined by PUAs), with a higher level of entrepreneurship culture and/or a lower levels of Neuroticism, showed higher level of economic growth in terms of output and employment during our sample period 1981–2013.

Our second contribution is that we address the issue of two-way causality between personality traits and economic outcomes, here economic growth, by developing an IV strategy that uses individual-level data. To our knowledge, we are the first to instrument the personality traits with traumatic experience and thereby to use an instrument at the same individual level as the level on which these traits themselves are measured, instead of using instruments that are based on aggregate data (see e.g., Lee, 2017; Stuetzer et al., 2018).

Our analysis and findings give rise to the following theoretical implications. First of all, the inclusion of personality traits and in particular the fact that they are spatially clustered enriches the field of economic geography because it offers a novel and individual foundation of local informal institutions which may be an important factor associated with persistent economic differences across space (Martin and Sunley, 2015; Martin et al., 2016b). Of course, standard and well-documented explanations of (differences in) local economic outcomes like the degree of specialisation, agglomeration or a region's economic history remain as relevant as ever, but the inclusion of geographical psychology may well be an important complement to these more structural explanations.

Second, our study also contributes to the emerging literature on geographical psychology in two ways. We find evidence that both the variable-oriented and the person-oriented approach (Magnusson and Torestad, 1993) to regionally clustered personality traits should be taken into consideration because both may be linked to economic growth via Neuroticism and entrepreneurship culture, respectively. To date, these two approaches typically are investigated separately. In the psychological literature on personality traits, both approaches are deemed relevant, and our findings substantiate the idea that it is useful to apply both approaches (Obschonka et al., 2013). In addition, our study is among the first to provide firm evidence that regionally clustered personality traits are associated with economic growth by deploying an IV-strategy that relies on a new and unique instrument. We show that traumatic experience strongly correlates to the Big Five personality traits and not to urban economic growth. More generally, previous research into the relationship between geographically clustered personality traits and outcome variables has focused on finding correlations, without addressing the two-way causality issue.

The relationship between personality traits and economic outcomes is likely to be a two-way relationship over time. It has for instance been shown (Wille and De Fruyt, 2014) that personality traits not only shape the occupational choices of individuals but also that these choices in turn influence personality traits. This is in line with other studies that have demonstrated how the impact of a region's past economic

development path can still be detected in the personality traits of the region's population even long after that earlier pattern of economic development has disappeared (Stuetzer et al., 2016).

An intriguing but difficult issue is what our findings might imply for policies aimed at improving the fortunes of economically distressed or lagging localities. One possible implication concerns the debate over people- and place-based policies. Given the two way relationship between the economic conditions in a place and the psychological make-up of its population, making a distinction between place-based or people-based (or place-neutral) policies may not be very fruitful, since the informal institutions that characterise a place and its economic performance are to some extent shaped by people's personality traits and at the same time people's outlooks and personality traits are shaped, again to some extent, by the place that they live in. This strengthens the case for so-called 'place-sensitive' policies (Iammarino et al., 2017) which take local informal institutions, like entrepreneurship culture, and measures to support and nurture local social and cultural capital and resources, explicitly into account.

As we have acknowledged, personality traits are not fixed and immutable, but can change over time, see the extensive survey by Tasselli et al. (2018). For example, Almlund et al. (2011) show in an extensive survey how education and parental investment can affect an individual's personality traits throughout the lifecycle. In particular, they suggest that such interventions are most effective in early-life stage. Their findings also indicate that investments in the development of personality skills have a larger impact than investments in cognitive skills. Locally targeted and locally based social policies would seem to be as important as locally specific economic interventions.

To conclude, we strongly believe that the infusion of insights from psychology, of which personality traits research is an example, into the field of economic geography can contribute to our understanding of the main research question as to what shapes the uneven allocation of economic activity, performance and prosperity across space. We want to stress, however, that our paper only provides initial exploratory evidence on the importance of individual characteristics for economic outcomes, and that much more research is needed along various dimensions. To start with, one would like to know more about the processes or mechanisms via which these personality traits influence an individual's economic behaviour. More research is also needed with respect to the actual behaviours that form the transmission between personality traits and local economic outcomes.

In addition, the empirical support for our findings has to be extended and tested considerably by looking at different spatial settings, and possibly using more sophisticated recursive models of two-way interrelationships between traits and local economic outcomes. The latter would ideally require time-series data on traits, but unfortunately such information is very scarce. Nevertheless, together with other related recent studies like those of Lee (2017) and Obschonka et al. (2016), our findings provide sufficient warrant for a research agenda in economic geography where insights from psychology are actively used to increase our understanding of the observed spatial differences in economic prosperity and performance, and how local socio-economic context itself might help us to understand the economic behaviours and actions of individuals.

Supplementary material

Supplementary data for this paper are available at *Journal of Economic Geography* online.

References

- Adorno, I. W., Frenkel-Brunswik, E., Levinson, D. J., Sanford, R. N. (1950) *The Authoritarian Personality*. New York: Harper & Row.
- Allik, J., McCrae, R. R. (2004) Toward a geography of personality traits: patterns of profiles across 36 cultures. *Journal of Cross-Cultural Psychology*, 35: 13–28.
- Almlund, M., Duckworth, A. L., Heckman, J. J., Kautz, T. D. (2011) Personality psychology and economics (No. w16822). National Bureau of Economic Research.
- Angrist, J. D., Imbens, G. W., Rubin, D. B. (1996) Identification of causal effects using instrumental variables. *Journal of the American Statistical Association*, 91: 444–455.
- Asendorpf J. B. (2003) Head-to-head comparison of the predictive validity of personality types and dimensions. *European Journal of Personality*, 17: 327–346.
- Aslam, A., Corrado, L. (2012) The geography of well-being. *Journal of Economic Geography*, 12: 627–649.
- Barrick, M. R., Mount, M. K. (1991) The big five personality dimensions and job performance: a meta-analysis. *Personnel Psychology*, 44: 1–26.
- Barrick, M. R., Mount, M. K., Judge, T. A. (2001) Personality and performance at the beginning of the new millennium: what do we know and where do we go next? *International Journal of Selection and Assessment*, 9: 9–30.
- Bernile, G., Bhagwat, V., Rau, P. R. (2017) What doesn't kill you will only make you more risk-loving: early-life disasters and CEO behavior. *The Journal of Finance*, 72: 167–206.
- Beugelsdijk, S. (2007) Entrepreneurial culture, regional innovativeness and economic growth. *Journal of Evolutionary Economics*, 17: 187–210.
- Brakman, S., Garretsen, H., Van Marrewijk, C. (2009) *The New Introduction to Geographical Economics*. Cambridge, UK: Cambridge University Press.
- Cobb-Clark, D. A., Schurer, S. (2012) The stability of big-five personality traits. *Economic Letters*, 115: 11–15.
- Duranton, G., Puga, D. (2004) Micro-foundations of urban agglomeration economies. In J. V. Henderson and J. F. Thisse (eds) *Handbook of Regional and Urban Economics*, pp. 2064–2117. London: Elsevier B.V.
- Gardiner, B., Martin, R., Sunley, P., Tyler, P. (2013) Spatially unbalanced growth in the British economy. *Journal of Economic Geography*, 13: 889–928.
- Garretsen, H., Martin, R. L. (2010) Towards more credible (new) economic geography models: taking geography and history seriously. *Spatial Economic Analysis*, 5: 127–160.
- Garretsen, H., Martin, R. L. (2011) The Journal of Economic Geography a decade on: where do we go from here? *Journal of Economic Geography*, 11: 207–213.
- Garretsen, H., Stoker, J. I., Soudis, D., Martin R. L., Rentfrow, P. J. (2018) Brexit and the relevance of regional personality traits: more psychological openness could have swung the vote. *Cambridge Journal of Regions, Economy and Society*, 11: 165–175.
- Gertler, M. S. (2010) Rules of the game: the place of institutions in regional economic change. *Regional Studies*, 44: 1–15.
- Huggins, R., Thompson, P. (2016) Socio-spatial culture and entrepreneurship: some theoretical and empirical observations. *Economic Geography*, 92: 269–300.
- Huggins, R., Thompson, P. (2019) The behavioural foundations of urban and regional development: culture, psychology, and agency, *Journal of Economic Geography*, 19: 121–146.
- Iammarino, S., Rodriguez-Pose, A., Storper, M. (2017) Why Regional Development Matters for Europe's Economic Future. Working Paper 07/2017, European Commission, DG regional and urban policy.

- John, O. P., Srivastava, S. (1999) The big five trait taxonomy: history, measurement, and theoretical perspectives. In L. A. Pervin and P. John Oliver (eds) *Handbook of Personality: Theory and Research*, 2nd ed edn. , pp. 102–139. New York: Guilford.
- John, O. P., Naumann, L. P., Soto, C. J. (2008) Paradigm shift to the integrative Big Five trait taxonomy: history, measurement, and conceptual issues. In O. P. John, R. W. Robins, and L. A. Pervin (eds) *Handbook of Personality: Theory and Research*, pp. 114–158. New York: Guilford.
- Jokela, M., Bleidorn, W., Lamb, M. E., Gosling, S. D., Rentfrow, P. J. (2015) Geographically varying associations between personality and life satisfaction in the London metropolitan area. *Proceedings of the National Academy of Sciences*, 112: 725–730.
- Klotz, A. C., Neubaum, D. O. (2015) Research on the dark side of personality traits in entrepreneurship: observations from the organizational behaviour perspective. *Entrepreneurship Theory and Practice*, 40: 7–17.
- Lee, N. (2017) Psychology and the geography of innovation. *Economic Geography*, 93: 106–130.
- Lewin, K. (1936) *Principles of Topological Psychology*. New York: McGraw Hill Book Company.
- Magnusson D., Torestad B. (1993) A holistic view of personality: a model revisited. *Annual Review of Psychology*, 44: 427–452.
- Martin, R. L. (2000) Institutional approaches in economic geography, Chap 5. In E. Sheppard and T. Barnes (eds) *A Companion to Economic Geography*, pp. 77–94. Oxford: Blackwell.
- Martin, R. L. (2015) Rebalancing the spatial economy: the challenge for regional theory. *Territory, Politics, Governance*, 3: 235–272.
- Martin, R. L., Gardiner, B., Tyler, P. (2014) The evolving economic performance of UK cities: city growth patterns, 1981–2011. Foresight Future Cities Working Paper, UK Government Office for Science, London.
- Martin, R. L., Sunley, P. (2015) On the notion of regional economic resilience: conceptualization and explanation. *Journal of Economic Geography*, 15: 1–42.
- Martin, R. L. (2016) Divergent urban development: reflections on a tale of two cities. *Regional Studies*, 50: 1623–1627.
- Martin, R. L., Sunley, P., Tyler, P., Gardiner, B. (2016a) Divergent cities in postindustrial Britain. *Cambridge Journal of Regions, Economy and Society*, 9: 269–299.
- Martin, R. L., Sunley, P., Gardiner, B., Tyler, P. (2016b) How regions react to recessions: resilience and the role of economic structure. *Regional Studies*, 50: 561–585.
- McCrae, R. R., Costa, P. T. Jr. (1999) A five-factor theory of personality. In L. A. Pervin and O. P. John (eds) *Handbook of Personality: Theory and Research*, 2nd ed edn. , pp. 139–153. New York: Guilford Press.
- McCrae, R. R., Terracciano, A. (2008) The five-factor model and its correlates in individuals and cultures. In: F. J. R. Van de Vijver, D. A. van Hemert, and Y. Poortinga (eds) *Individuals and Cultures in Multi-Level Analysis*, pp. 249–203. Mahwah (NJ): Erlbaum.
- Miller, D. (2015) A downside to the entrepreneurial personality. *Entrepreneurship Theory and Practice*, 39: 1–8.
- Obschonka, M., Schmitt-Rodermund, E., Silbereisen, R. K., Gosling, S. D., Potter, J. (2013) The regional distribution and correlates of an entrepreneurship-prone personality profile in the United States, Germany, and the United Kingdom: a socioecological perspective. *Journal of Personality and Social Psychology*, 105: 104–122.
- Obschonka, M., Stuetzer, M., Gosling, S. D., Rentfrow, P. J., Lamb, M. E., Potter M. E., Audretsch, D. B. (2015) Entrepreneurial regions: do macro-psychological cultural characteristics of regions help solve the ‘knowledge paradox’ of economics? *PLoS One*, 10: e0129332. Available online at: <http://dx.doi.org/10.1371/journal.pone.0129332>.
- Obschonka, M., Stuetzer, M., Audretsch, D. B., Rentfrow, P. J., Potter, J., Gosling, S. D. (2016) Macro-psychological factors predict regional economic resilience during a major economic crisis. *Social Psychological and Personality Science*, 7: 95–104.
- Rentfrow, P. J. (2013) Geographical differences in personality. In P. J. Rentfrow (ed.) *Geographical Psychology: Exploring the Interaction of Environment and Behavior*, pp. 115–137. Washington (DC): American Psychological Association.
- Rentfrow, P. J., Gosling, S. D., Potter, J. (2008) A theory of the emergence, persistence, and expression of geographic variation in psychological characteristics. *Perspectives on Psychological Science*, 3: 339–369.

- Rentfrow, P. J., Jokela, M., Lamb, M. E. (2015) Regional personality differences in Great Britain. *PLoS One*, 10: e0122245.
- Roberts, B. W., Walton, K. E., Viechtbauer, W. (2006) Patterns of mean-level change in personality traits across the life course: a meta-analysis of longitudinal studies. *Psychological Bulletin*, 132: 1–25.
- Rodríguez-Pose, A., Storper, M. (2006) Better rules or stronger communities? On the social foundations of institutional change and its economic effects. *Economic Geography*, 82: 1–25.
- Schaller, M., Murray, D. R. (2008) Pathogens, personality and culture: disease prevalence predicts worldwide variability in sociosexuality, extraversion, and openness to experience. *Journal of Personality and Social Psychology*, 95: 212–221.
- Schoar, A., Zuo, L. (2017) Shaped by booms and busts: how the economy impacts CEO careers and management styles. *The Review of Financial Studies*, 30: 1425–1456.
- Specht, J., Egloff, B., Schmukle, S. C. (2011) Stability and change of personality across the life course: the impact of age and major life events on mean-level and rank-order stability of the Big Five. *Journal of Personality and Social Psychology*, 101: 862–882.
- Stewart, W. H. , Jr., Roth, P. L. (2001) Risk propensity differences between entrepreneurs and managers: a meta-analytic review. *Journal of Applied Psychology*, 86: 145–153.
- Storper, M. (2013) *Keys to the City: How Economics, Institutions, Social Interaction, and Politics Shape Development*. Princeton: Princeton University Press.
- Stuetzer, M., Audretsch, D. B., Obschonka, M., Gosling, S. D., Rentfrow, P. J., Potter, J. (2018) Entrepreneurship culture, knowledge spillovers and the growth of regions. *Regional Studies*, 52: 608–618.
- Stuetzer, M., Obschonka, M., Audretsch, D. B., Wyrwich, M., Rentfrow, P. J., Coombes, M., Shaw-Taylor, L., Satchell, M. (2016) Industry structure, culture, and entrepreneurship. An empirical assessment using historical coalfields. *European Economic Review*, 86: 52–72.
- Tasselli, S., Kilduff, M., Landis, B. (2018) Personality change: implications for organization behavior. *Academy of Management Annals*. <https://doi.org/10.5465/annals.2016.0008>.
- Twenge, J. M. (2000) The age of anxiety? The birth cohort change in anxiety and neuroticism, 1952–1993. *Journal of Personality and Social Psychology*, 79: 1007–1021.
- Van de Vliert, E. (2013) Climato-economic habitats support patterns of human needs, stresses, and freedoms. *Behavioral and Brain Sciences*, 36: 465–480.
- Van der Linden, D., te Nijenhuis, J., Bakker, A. B. (2010) The general factor of personality: a meta-analysis of Big Five intercorrelations and a criterion-related validity study. *Journal of Research in Personality*, 44: 315–327.
- Wille, B., De Fruyt, F. (2014) Vocations as a source of identity: reciprocal relations between Big Five personality traits and RIASEC characteristics over 15 years. *Journal of Applied Psychology*, 99: 262–281.
- Zhao, H., Seibert, S. E., Lumpkin, G. T. (2010) The relationship of personality to entrepreneurial intentions and performance: a meta-analytic review. *Journal of Management*, 36: 381–404.

Appendix

Table A1. Big five personality domains and Big Five Inventory (BFI) items that load on them

Big five personality domain	BFI item
Openness	Is original, comes up with new ideas
	Is curious about many different things
	Is ingenious, a deep thinker
	Has an active imagination
	Is inventive
	Values artistic, aesthetic experiences
	Likes to reflect, play with ideas
	Is sophisticated in art, music or literature
	Prefers work that is routine (r)
	Has few artistic interests (r)
Conscientiousness	Does a thorough job
	Is a reliable worker
	Perseveres until the task is finished
	Does things efficiently
	Makes plans and follows through with them
	Can be somewhat careless (r)
	Tends to be disorganised (r)
	Tends to be lazy (r)
Extraversion	Is easily distracted (r)
	Is talkative
	Is full of energy
	Generates a lot of enthusiasm
	Has an assertive personality
	Is outgoing, sociable
	Is reserved (r)
	Tends to be quiet (r)
Agreeableness	Is sometimes shy, inhibited (r)
	Is helpful and unselfish with others
	Has a forgiving nature
	Is generally trusting
	Is considerate and kind to almost everyone
	Likes to cooperate with others
	Tends to find fault with others (r)
	Starts quarrels with others (r)
Neuroticism	Can be cold and aloof (r)
	Is sometimes rude to others (r)
	Is depressed, blue
	Can be tense
	Worries a lot
	Can be moody
	Gets nervous easily
	Is relaxed, handles stress well (r)
	Is emotionally stable, not easily upset (r)
	Remains calm in tense situations (r)

Notes: The stem for each BFI item is “I see myself as someone who” The source of the BFI items is John and Srivastava (1999). (r) = reverse keyed item.

Table A2. Primary urban areas (PUA) and constituting local district authorities (LAD)

PUA	Local district authorities	PUA	Local district authorities
Aberdeen	Aberdeen City	Liverpool	St. Helens, Liverpool, Knowsley
Aldershot	Rushmoor	London	Brent, Westminster, Southwark, Camden, Hillingdon, Lewisham, Dacorum, Harrow, Bromley, Tower Hamlets, Enfield, Waltham Forest, Havering, Wandsworth, Ealing, Haringey, Kingston upon Thames, Hackney, Barnet, Hammersmith and Fulham, Barking and Dagenham, Sutton, Broxbourne, Merton, Bexley, Newham, Croydon, Lambeth, Islington, City of London, Hounslow, Redbridge, Gravesham, Greenwich, Three Rivers, Kensington and Chelsea, Epping Forest, Richmond upon Thames
Barnsley	Barnsley	Luton	Luton
Birkenhead	Wirral	Manchester	Salford, Trafford, Bury, Manchester, Stockport, Tameside, Oldham
Birmingham	Dudley, Sandwell, Walsall, Birmingham, Wolverhampton, Solihull	Mansfield	Mansfield, Ashfield
Blackburn	Blackburn with Darwen	Middlesbrough	Stockton-on-Tees, Redcar and Cleveland, Middlesbrough
Blackpool	Blackpool, Wyre, Fylde	Milton Keynes	Milton Keynes
Bolton	Bolton	Newcastle	South Tyneside, Gateshead, Newcastle upon Tyne, North Tyneside
Bournemouth	Poole, Bournemouth, Christchurch	Newport	Newport
Bradford	Bradford	Northampton	Northampton
Brighton	Brighton and Hove	Norwich	Broadland, Norwich
	Adur	Nottingham	Broxtowe, Gedling, Nottingham, Erewash
Bristol	South Gloucestershire, City of Bristol	Oxford	Oxford
Burnley	Burnley, Pendle	Peterborough	Peterborough
Cambridge	Cambridge	Plymouth	Plymouth
Cardiff	Cardiff	Portsmouth	Havant, Fareham, Portsmouth, Gosport
Chatham	Medway	Preston	South Ribble, Chorley, Preston
Coventry	Coventry	Reading	Bracknell Forest, Wokingham, Reading
Crawley	Crawley, Reigate and Banstead	Rochdale	Rochdale
Derby	Derby	Sheffield	Rotherham, Sheffield
Doncaster	Doncaster	Southampton	Southampton, Eastleigh
Dundee	Dundee City	Southend	Southend-on-Sea, Castle Point, Rochford
Edinburgh	City of Edinburgh	Stoke	Stoke-on-Trent, Newcastle-under-Lyme
Glasgow	West Dunbartonshire, Glasgow City, East Dunbartonshire, Renfrewshire, East Renfrewshire	Sunderland	Sunderland
Gloucester	Gloucester	Swansea	Swansea
Grimsby	North East Lincolnshire	Swindon	Swindon
Hastings	Hastings	Telford	Telford and Wrekin
Huddersfield	Kirklees	Wakefield	Wakefield
Hull	Kingston upon Hull, City of	Warrington	Warrington
Ipswich	Ipswich	Wigan	Wigan
Leeds	Leeds	Worthing	Worthing
Leicester	Oadby and Wigston, Blaby, Leicester	York	York