Relative Income, Happiness and Urban-Rural Differentials

A quantitative study into the relationship between relative income and happiness of urban and rural populations in England

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ABSTRACT

Since the start of the 21st century, an increasing body of literature on the 'Science of Happiness' emerged, giving rise to studies on the drivers of happiness. These studies have included a wide range of explanatory variables to better understand what drives individuals' happiness. Yet, oftentimes these studies included only a set of variables within a specific domain relating to happiness, such as relative income, social capital, or deprivation. This study aims to build on the efforts of earlier research on happiness by providing an overarching framework, including variables from various domains within the Science of Happiness, to create a wider understanding of happiness. The main focus is placed on the effects of relative income on the happiness of urban and rural populations in England. By studying relative income, social comparison and urban-rural differentials, this study addresses the relative paucity of studies on these subjects. Using Ordinary Least Squares and Ordered Logistic Regression as estimation techniques, the contribution of relative income to subjective well-being and life satisfaction has been studied. The results of this study have shown that, in 2019, rural high-income individuals reported significantly higher scores on their happiness compared to urban middle-income individuals. Contrary, rural middle- and low-income individuals were not found to report significantly different happiness levels than urban middle-income individuals. A similar phenomenon was observed for life satisfaction, where rural individuals within the highest income group reported significantly higher scores than urban middle-income individuals. However, the effects of relative income on happiness were found to be inconclusive when analysing four waves during the period 2010-2019. To conclude, this study found that the extent to which there is a difference in the way relative income influences happiness of the urban and rural populations in England depends on the income groups and year considered.

Keywords. Happiness, life satisfaction, relative income, urban-rural differentials.

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1 INTRODUCTION

This paper studies the extent to which relative income affects individuals' happiness in England, and whether this effect is different for urban and rural populations.

Since the start of the 21st century, an increasing body of literature on the 'Science of Happiness' has emerged. This new field focusses on the drivers of happiness and their impact on the reported happiness of individuals. Questions on happiness are increasingly used in social surveys, which enables analyses on the demographic, socio-economic, and contextual influences of happiness (Ballas, 2013). Not only does this enable more research on happiness, but it can also satisfy the need for a better understanding as to what drives the happiness of individuals. This understanding is crucial for the development of better policies and decision-making, especially on the local level (Ma et al., 2018; Diener & Ryan, 2009). Spatial inequalities between regions in terms of living conditions, potentials, amenities, and many more factors raise the need for reconsideration of policy at the local level. To improve the local situation, governments need to include citizens' perspectives in the development of strategy and policy. Furthermore, a better understanding of citizens' experiences and happiness helps to achieve social and societal goals, like increased employment, economic growth, and equity and equality (OECD, 2014). In turn, achieving such goals stimulates welfare (Ma et al., 2018).

The ONS (2020) has observed differences in the average reported happiness of UK citizens between regions, where some regions show higher averages than others. Figure 1 shows the personal happiness levels reported in the UK in 2019 based on the Annual Population Survey, where darker blue colours indicate higher reported happiness. This map shows regional differences in reported happiness, ranging from an average of 6.5 to 8.7 on a 10 point scale (ONS, 2020). By identifying the reasons for these spatial inequalities, policies can be adapted to fit specific types of regions.

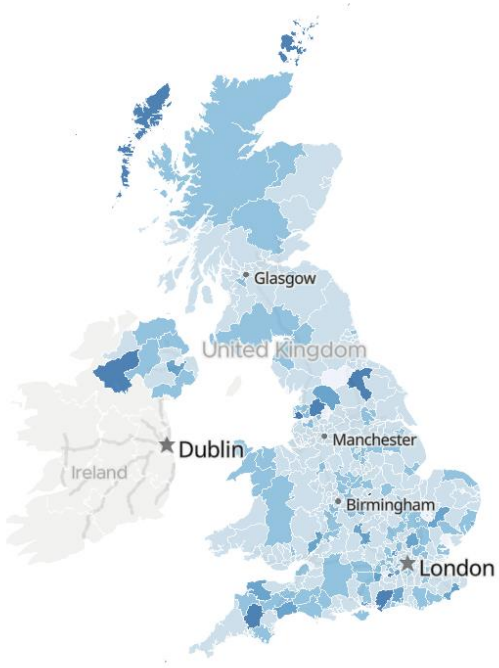

Figure 1. Personal happiness in the UK in 2019 (ONS, 2020)

Wong et al. (2006) found evidence that social policy increases well-being. Income, basic needs fulfilment, and income redistribution are often included in social policy to improve life satisfaction, well-being, and happiness. The importance of income for happiness can be explained by the idea that it enables individuals to meet their basic needs. In previous research, it has been found that income is an important driver in life satisfaction and subjective well-being. High-income countries tend to report higher levels of life satisfaction than medium- and low-income countries or countries with high income inequality (Ng & Diener, 2019; Diener et al., 2010; Wong et al., 2006). Furthermore, from a societal macro perspective, higher income leads to generally better health of a population, which, in turn, can be the source of higher levels of happiness (Pierewan & Tampubolon, 2015). Figure 2 presents income inequality in the UK during the period from 1977 to 2020. The Gini coefficient is used as a measurement tool, which is a popular tool to measure inequality regarding the income distribution. In their extremes, the value of 0 and 100 percent represent complete equality and complete inequality respectively. Over the entire period, income inequality has been rising, ending in 2020 with an increase of 2.2 percent (ONS, 2021). Compared to other European countries, income inequality is very prominent in the UK income distribution. In 2018, the UK ranked fourth out of 37 OECD countries on the list of highest income inequality (OECD, 2021).

The presence of spatial inequalities in happiness levels and the increasing income inequality in the UK raise the need for further scientific research on the causes of these phenomena and how they are related.

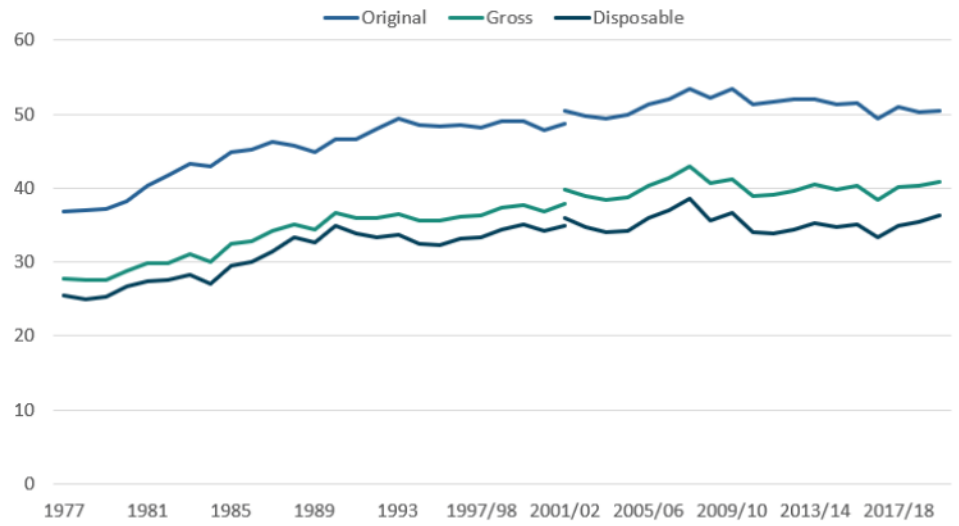

Figure 2. Income inequality in the UK 1977-2020 measured by the Gini coefficient (ONS, 2021)

Within the literature on the Science of Happiness, a key distinction can be made between *quality of life* studies and *happiness* studies. *Quality of life* studies measure the objective contributors, such as crime

rates and the availability of housing. Contrary, *happiness* studies more often include subjective measures of well-being, where there is an emphasis on the experiences and feelings of individuals (Majeed & Samreen, 2020; Ballas, 2013; Rogerson et al., 1989). The relationship between happiness and income has often been subject of study within the Science of Happiness. Such studies focused on absolute income, as well as relative income and the effects of social comparison. Ball & Chernova (2008) argue that an increase in absolute income can lead to higher reported happiness as people experience higher welfare. However, individuals' happiness is mostly affected by relative income. The relative-income hypothesis suggests that happiness depends on how an individual's income compares to a specific reference group. An increase in income leads to an increase in happiness, letting all else stay equal, as your relative position improves (Boyce et al., 2010). However, there have been debates on the evidence for such a relationship (Ballas, 2013; Ng & Diener, 2019). Social comparison has a large influence on relative income. Individuals tend to compare themselves to a reference group with which they identify (Ballas, 2013). Tobler (1970) introduced the importance of the reference group to be spatially close, which was followed up by the findings of Rijnks et al. (2019) that the increasing proximity of similar others significantly impacts the relationship between relative income and subjective well-being.

Another key characteristic of the effect of income and its relationship with happiness is how they behave over time. While the average level of income can increase over time, happiness does not increase with it. The cause of this phenomenon is that your relative income position generally remains similar. As a result of social comparison, one's happiness remains similar as well (Easterlin & O'Connor, 2020; Easterlin, 1974).

There also have been considerable efforts to study the effects of other drivers on happiness. Researchers like Coleman (1988) and Putnam (1993) have had a major influence within the field of social capital theory. Their works presented a framework on the influence of trust, norms, and interpersonal relationships. Neira et al. (2018) found evidence that differences in social capital can explain the regional differences in reported happiness levels. Furthermore, a more recent focus has been placed on deprivation and geographical distances. Increasing geographical distances to specific locations, such as cities or nature, may cause individuals to experience deprivation (Schneider et al., 2020). Deprivation threatens happiness of citizens as a result of social exclusion, low levels of social participation, and no feelings of empowerment. Consequently, deprivation leads to a decrease in subjective well-being (Cuesta & Budría, 2014).

Thus, studies on happiness have included a wide range of explanatory variables to better understand what drives individuals' happiness. Yet, oftentimes these studies included only a set of variables within a specific domain relating to happiness, such as relative income, social capital, or deprivation. The body of literature lacks an overarching study to simultaneously account for the various domains within the Science of Happiness. Furthermore, there remains a need to incorporate a geographical dimension to gain better insights into the spatial effects of phenomena on cities and regions (Ballas, 2013; Alesina et al., 2004).

This study aims to build on the efforts of earlier research on happiness by providing an overarching framework, including variables from various domains, to create a wider understanding of happiness. The main focus is placed on the effects of relative income on the happiness of urban and rural populations in England. The observed regional differences in happiness and income make England an interesting case. Moreover, English rural areas are characterised by relatively large distances between people, whereas urban areas contrast this view (Dijkstra et al., 2020). Therefore, the spatial context of urban and rural is applied to find out whether and how this influences the relationship between relative income and happiness. To achieve this, the following research question has been constructed: "*To what extent is there a difference in the way relative income influences happiness of the urban and rural populations in England?*". To answer this question, the following secondary questions are relevant:

1. What are the main drivers of individuals' happiness according to the current body of literature?

2. How does relative income influence happiness of individuals living in rural areas compared to those living in urban areas of England?

3. What difference can be observed for the effect of relative income between the subjective and objective measures of happiness for individuals in England?

4. How did the effect of relative income on happiness evolve over time in England?

To study the impact of relative income on happiness, information about reported happiness, and demographic, socio-economic, and contextual characteristics is necessary. Questions on happiness are more often used in social surveys (Ballas, 2013), which enables analysis focussing on happiness. One of the surveys including happiness questions is the Understanding Society dataset (https://www.understandingsociety.ac.uk/), which is a longitudinal household survey in the UK. This dataset includes high-quality data on a wide range of demographic characteristics and other socio-economic contextual factors. As a result, this dataset allows for statistical analysis on a variety of social phenomena. Using the Understanding Society dataset, this paper presents a quantitative analysis based on various regression models to study the effect of relative income on happiness in England.

The remainder of this study is structured as follows. Chapter 2 reflects on the current body of literature which supports the conceptual model. Continuing, chapter 3 presents the conceptual model and hypotheses following from the literature. Chapter 4 discusses the methodological basis and important choices for this study. Chapter 5 presents the results of the analysis, as well as the diagnostic testing and robustness checks. Chapter 6 provides a discussion on the findings and their implications, after which the study ends with the conclusion in chapter 7.

2 THEORETICAL FRAMEWORK

This chapter discusses the theoretical framework embedded in this study. To start, the difference between *quality of life* and *happiness* studies is discussed in more depth, after which the main drivers of happiness and their relationship to happiness are addressed. Furthermore, the relationship between happiness and income is studied in detail. The current body of literature and key theories within the Science of Happiness provide a basis for further analysis. The chapter ends with a discussion on the urban-rural geographical context within the framework of happiness.

2.1 Quality of life or happiness?

Although the Science of Happiness only emerged at the beginning of the 21st century, some studies in human geography and regional economics relating to subjective well-being and life satisfaction date from the first half of the 20th century. The first studies started with objective measurements of well-being, only to switch to subjective measurements in more recent years. This leads to an important distinction: *quality of life* studies and *happiness* studies.

Quality of life studies focus on the objective measurement of well-being and the cognitive outcomes of life (Puntscher et al., 2015; Neira et al., 2018). Ziogas & Ballas (2021) argue that the objective measurement is based on external characteristics, such as GDP, which can bestow on happiness. Traditionally, the drivers of quality of life have been divided into two dimensions; social and physical environmental drivers (Rogerson et al., 1989). The social environment includes drivers such as crime rates, education, health services, and housing. Contrary, the physical environment includes climate, topography, pollution, and recreation (Rogerson et al., 1989; Ballas, 2013). The quantity and quality of amenities can be applied as measurement for the quality of life in cities as they make a place attractive (Ballas, 2013), forming a basis for analysis. Tiebout's (1956) 'voting with their feet' theory, where public amenities and taxes determine location decisions, and the concept of 'plane of living' by Goodrich et al. (1935) to explain spatial and economical differentials, are typical examples of quality of life research. They embody amenities and characteristics of the built environment to explain quality of life. The underlying reason for individuals to 'enjoy' life is the achievement of certain outcomes in life (Veenhoven, 2001), which causes quality of life to be rather materialistic.

Whereas quality of life includes objective measures, happiness studies focus on subjective measurements and the emotional outcomes of life (Neira et al., 2018). Happiness is key for individuals to perform at their best and to experience feelings of intellect and strength (Majeed & Samreen, 2020). Data on such feelings is retrieved from questions relating to how happy someone feels, being increasingly used in social surveys (Ballas, 2013). Quality of life depends on the outcome, while happiness is characterised by the evaluation of life as a whole, which embodies all steps taken to reach the outcome. Therefore, happiness is more dependent on subjective feelings experienced throughout

life, rather than being satisfied or unsatisfied with the outcome (Veenhoven, 2001; Neira et al., 2018; Puntscher et al., 2015).

Although the current body of literature describes the distinction between *quality of life* and *happiness*, overlap remains between the two (Puntscher et al., 2015). As a result, in some cases the concepts are used interchangeably. Dolan et al. (2008) and Cuesta & Budría (2014) present the concept of *life satisfaction* as a measurement for *happiness*, whereas Puntscher et al. (2015) and Neira et al. (2018) argue that this concept measures the *quality of life*.

To better understand happiness, it is important to focus on the contribution of different drivers. For this study, the drivers of happiness are divided into two sub-groups. The first sub-group focuses on the individual and household attributes of happiness, such as age and employment. The second sub-group includes the contextual attributes of happiness, e.g., social capital. The next sections present the relevant drivers and elaborates on their impact.

2.2 Individual and household attributes of happiness

Two of the main individual demographic attributes to happiness are age and gender. The relationship between happiness and age is represented by a U-shape; people tend to report higher levels of happiness during their younger and older phases of life (Ballas, 2013; Blanchflower & Oswald, 2008; Ballas, 2021). Although the U-shape does not change, shifts in age are observed over the years. Over the period of approximately two decades, the happiness-minimising age has shifted from 36 (Clarke, 2003) to 48 (Blanchflower, 2020). The U-shaped relationship is found in all types of countries and, thus, does not depend on factors like the economy or living standards (Blanchflower, 2020). Furthermore, differences in happiness between genders show that women oftentimes tend to report slightly higher levels of happiness than man (Ballas, 2013). Montgomery (2016) adds that women rate their happiness higher, although their lives have the same objective outcomes as those of men with lower happiness rates reported.

Regarding household composition, it is important to control for the number of children in the household. In the past, the number of children has oftentimes been found to have a negative effect on happiness (Alesina et al., 2004; Angeles, 2010). However, Angeles (2010) found that children can increase happiness when certain conditions are met, such as the right timing and marital status. Marital status is a key factor influencing whether children have a positive or negative influence. Married individuals more often experience positive effects from having children, whereas separated individuals can be faced with negative feelings (Angeles, 2010). Next to this, marital status also has a direct influence on happiness and life satisfaction. Previous studies have shown that marriage positively affects happiness, where married individuals report higher happiness than their unmarried peers. Wadsworth (2016) argues that this difference is mainly caused by the cultural acceptance of marriage, where marriage may even be viewed as something to be accomplished.

Furthermore, happiness can be affected by the type of tenant an individual is categorised as. In the literature, homeownership and renting have generally been compared. Homeownership has been found to have a significant positive effect on happiness. However, this observation is hugely affected by the norm in society. If homeownership is the norm in a society, individuals experience an increase in happiness when they own a home compared to rent a home. Both comparisons made to peers and individuals' status in society are driving forces behind the relationship between homeownership and happiness (Foye et al., 2018; Rohe & Basolo, 1997).

The professional lives of individuals, education, employment status, and income can influence happiness as well. For employment, it is mainly the negative impact of being unemployed over a longer period which has major effects on happiness (Clark, 2003; Easterlin, 2012; Ballas, 2013). Furthermore, economies with higher rates of full employment generally observe higher average reported happiness levels (Easterlin, 2012). Happiness is directly and positively influenced by whether an individual is enrolled in education or not, although the education level oftentimes does not affect the size of the impact. The indirect effects of education are related to both income and employment status. Higher levels of education can increase happiness as an individual is more likely to be employed, and income is expected to be higher due to employment (Cuñado & De Gracia, 2012). Moreover, Blanchflower & Oswald (2004) found evidence that the number of years of education positively affects happiness. Although an increase in income can increase happiness, it does so with diminishing marginal returns. Thus, lower-income groups experience a larger increase in happiness when their income increases than high-income groups (Ballas, 2013; Ng & Diener, 2019). Moreover, income can influence happiness directly, as discussed above, as well as indirectly. A higher income can lead to better health, which, in turn, brings higher levels of happiness (Pierewan & Tampubolon, 2015; Dolan et al., 2008). Physical and mental health have a strong relationship with happiness, where especially mental health has high correlations with happiness. This finding can be explained by the positive feelings associated with psychological well-being. Contrary, health problems negatively impact happiness. However, this negative impact wears down as an individual structurally experiences these problems over a longer period (Dolan et al., 2008).

2.3 Contextual attributes of happiness

2.3.1 Social capital

Researchers like Coleman and Putnam have had a major influence within the field of social capital theory. Coleman (1988) defined social capital as "a variety of different entities, with two elements in common: they all consist of some aspects of social structures, and they facilitate certain actions of actors" (p. S98). He introduced the concept as consisting of three main elements: (1) trust, expectations, and obligations, (2) information channels, and (3) norms and sanctions. Putnam (1993) used the work

of Coleman (1988) as a basis, and further developed the understanding of social capital. He incorporated a focus on interpersonal relationships, referring to social capital as the "features of social organisations, such as networks, norms, and trust that facilitate action and cooperation for mutual benefit" (p. 35). This definition assumes that individuals are part of a larger social structure. Based on this concept, it is argued that a healthy and stable social network is an incentive for positive externalities, such as cohesion, trust, and economic growth (Rodriguez-Pose & Von Berlepsch, 2014). Neira et al. (2018) found evidence that differences in social capital can explain the regional differences in reported happiness. Moreover, Puntscher et al. (2015) have studied social capital in relation to both happiness and life satisfaction. This study presented evidence that social capital has a significant positive effect on individuals' happiness, although not on their life satisfaction.

Social capital is an important contributor to the happiness of individuals. Hoogerbrugge & Burger (2018) found that social capital within neighbourhoods is an important contributor to one's life satisfaction, especially for more vulnerable individuals. This is largely driven by the feeling of belonging. A better understanding of social capital within neighbourhoods can inform policy to tackle social isolation and exclusion. Furthermore, differences in social capital between urban and rural areas are important to consider. Rural areas are often assumed to be richer in social capital than urban areas (Helliwell et al., 2020; Sørensen, 2016). Sørensen (2016) argues that this view could be supported by the *Gemeinschaft* and *Gesellschaft* distinction by Tönnies. Gemeinschaft embodies communities where social cohesion and solidarity have a large role, which can be found in close friendships and small villages. Contrary, Gesellschaft represents communities with more individualism and weaker ties to other individuals, more often found in urban areas (Sørensen, 2016; Tönnies, 1887/1957). Furthermore, Mohnen et al. (2015) found that rural people experience higher levels of social capital on the neighbourhood level. However, there are some heterogeneous views as to whether social capital is more prominent in urban or in rural areas. Hofferth & Iceland (1998) already found mixed results on the question of whether social capital is stronger in rural areas than in urban areas. While rural populations may experience strong ties with family and receive support from these ties, they might lack other social capital ties and social participation. Furthermore, recently it has been found that urban populations report relatively more often that they have friends and family they can trust and get support from (Dijkstra & Papadimitriou, 2020). Dijkstra & Papadimitriou (2020) argue that in cities it takes less effort to engage in social interaction and there are more possibilities to meet others, resulting in the conclusion that "life in cities is socially more satisfying than in rural areas" (p.150). In the literature, the debate on the effect of social capital in urban and rural communities remains (Sørensen, 2016).

2.3.2 Deprivation

Deprivation is the second contextual attribute that is key to happiness. The concept of deprivation was introduced by Townsend (1987) as "a state of observable and demonstrable disadvantage relative to the local community or the wider society or nation to which an individual, family or group belongs" (p.125).

Deprivation includes many aspects of an individual's life as a set of conditions, whereas poverty is the outcome of one's circumstances (Townsend 1987; Ministry of Housing, Communities and Local Government, 2019). Furthermore, when geographical distances to certain locations are increasing, individuals may experience deprivation (Schneider et al., 2020). Deprivation threatens the happiness of individuals as a result of social exclusion, low levels of social participation, and no feelings of empowerment. Consequently, deprivation can lead to a decrease in subjective well-being and happiness.

In the literature, there are supporting arguments for the use of deprivation measurements to better understand shortcomings in resources. The multidimensional character is argued to better capture how individuals can experience impoverishment (Hick, 2016; Cuesta & Budría, 2014). Therefore, tools to measure levels of deprivation are very important to be considered by policy makers and authorities (Cuesta & Budría, 2014).

In England, the Ministry of Housing, Communities and Local Government publishes the Multiple Deprivation Index (MDI). The MDI is considered an official measure to analyse and compare deprivation levels throughout England. There are 39 indicators in total, divided among 7 domains: (1) income, (2) employment, (3) health deprivation, (4) education and training, (5) crime, (6) housing and services, and (7) the living environment. Higher scores on the MDI indicate that an area is more deprived. Figure 3 presents a map with the MDI scores on neighbourhood level in England in 2019. Pale green represents the least deprived areas, whereas dark blue represents the most deprived areas.

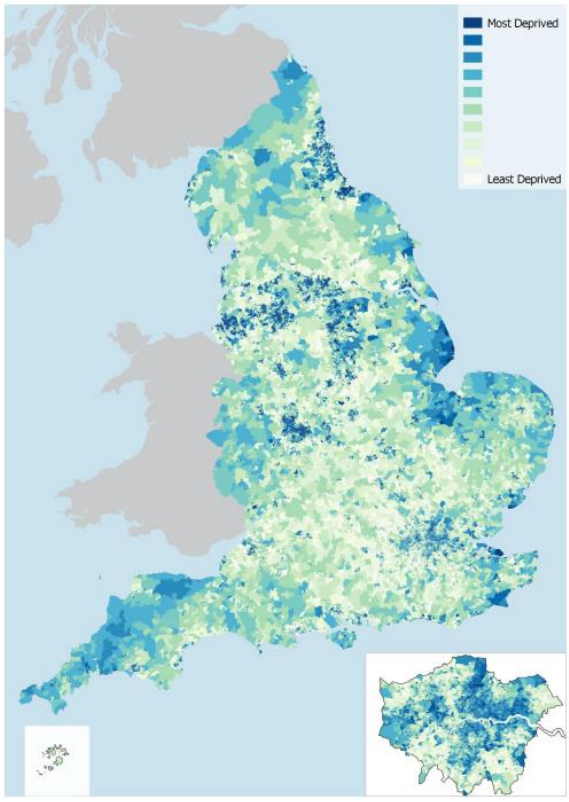

Figure 3. Distribution of the Multiple Deprivation Index 2019 by neighbourhoods in England (Ministry of Housing, Communities and Local Government, 2019)

The indices of 2019 show that there are clusters of deprived neighbourhoods in areas where, in the past, mining and industry were major industries (Ministry of Housing, Communities and Local Government, 2019). Such neighbourhoods are more often faced with socio-economic inequalities throughout time. Moreover, deprivation is often a locality-wide problem, which causes a pattern of deprived neighbourhood clusters. This phenomenon emphasises the need for local policy to create an opportunity for improvement (Rae, 2012).

2.4 Absolute income, relative income, and rank income

Happiness can be affected by the level of inequality in a population. The impact of various socio-economic factors tends to be more extreme in regions where there is more inequality. Income is such a socio-economic factor that impacts happiness levels. This effect can be caused by absolute income, as well as relative income (Ballas & Dorling, 2013; Ballas, 2013). Ball & Chernova (2008) argue that an increase in absolute income can lead to higher reported happiness as people experience higher welfare. The relationship between happiness and income is positive, but subject to diminishing marginal returns. This suggests that an increase in income leads to a smaller increase for high-income individuals than low-income individuals. However, there have been debates on the evidence for such a relationship (Ballas, 2013; Ng & Diener, 2019).

The effect of absolute income is argued to be dominated by relative income, which refers to one's income compared to the income of someone considered 'similar' or the regional average income. In the literature of income comparison and income effects, three hypotheses explain the relationship between income and happiness: (1) the absolute-income hypothesis, (2) the relative-income hypothesis, and (3) the rank-income hypothesis. The absolute-income hypothesis assumes that an increase in income leads to an increase in happiness. The relative-income hypothesis suggests that happiness depends on how individuals' income compares to a reference group. Thus, an increase in income leads to an increase in happiness letting all else stay equal. The rank-income hypothesis divides the population over rank-based income groups, where finding yourself in a higher income group leads to higher happiness (Boyce et al., 2010). Whereas the absolute income-hypothesis is a stand-alone phenomenon, the relative income-hypothesis and rank income-hypothesis depend on the effect of social comparison. Boyce et al. (2010) argue that evidence has shown that rank income is a better tool to explain the variation found in happiness compared to relative income and absolute income. This statement is based on the argument that rank income is best at reflecting the rank position of one individual to a reference group or regional average. The categorical comparison to other income groups would help to explain observed happiness and life satisfaction.

The tendency of people to compare themselves to others is rooted in history. Marx (1847) already discussed the importance of relative social status, illustrated by the following passage: "A house may be large or small; as long as the neighbouring houses are likewise small, it satisfies all social requirement for a residence. But let there arise next to the little house a palace, and the little house shrinks to a hut".

With this passage, Marx (1847) tries to stress the importance of a neighbour's status to how you feel. Social comparison can lead to inefficient choices and outcomes as people might decide to adjust utility and consumption based on the levels of the ones they compare to (Winkelmann, 2012). The perceived social status, combined with experienced levels of inequality, can cause individuals' happiness to be affected (Ballas & Dorling, 2013). Rijnks et al. (2019) studied the effect of relative income on the happiness of households in affluent and less affluent areas. They found that, in affluent areas, individuals with above national average income experience negative effects on their happiness. This is the result of social comparison to other households within the same affluent neighbourhoods, where utility is adjusted based on a reference group. This is referred to as the *comparative utility hypothesis*, and may result in inefficiency. Meanwhile, Rijnks et al. (2019) argue that no effect is found for those with a below national average income. In the less affluent areas individuals with above average incomes were found to experience higher happiness levels.

Furthermore, there is an interesting relationship between income and happiness over time. As aforementioned, the income of one individual relative to that of another individual can influence happiness levels. Happiness varies with income at one point in time within one single country. A sudden increase at a specific time can lead to a similar increase in happiness at this same time. However, this effect does not hold when the relationship between income and happiness over time is considered. Easterlin (1974) found that although income increases over time, happiness does not increase with it. This phenomenon is referred to as the 'Easterlin Paradox'. This theory is supported by the social comparison hypothesis, where the relativity of income dominates the effect on happiness. It is the income of an individual relative to another individual or a regional average at a specific time that affects happiness, rather than the progression of absolute income over time (Easterlin & O'Connor, 2020; Easterlin, 1974; Ma et al., 2018). However, Ball & Chernova (2008) reject the idea of the Easterlin Paradox and argue that there is no clear rationale as to why individuals would not value both high absolute and relative income. Yet, it is agreed upon that relative income provides a stronger base to explain happiness than absolute income.

2.5 Urban-rural differentials

Traditionally, the urban-rural divide has been depicted as a discrete construct; a locality is either urban or rural. However, more recently there is an understanding that the urban-rural divide is not as black and white. Rather, the Degree of Urbanisation measure gave rise to an urban-rural continuum, including a classification focussing on cities, towns and semi-dense areas, and rural areas (Dijkstra & Papadimitriou, 2020). Figure 4 uses the Degree of Urbanisation to differentiate between regions and captures how the category 'Towns and semi-dense areas' forms a middle group on the urban-rural continuum which behaves in its own way relative to cities and rural areas.

The observed differences in happiness and life satisfaction between urban and rural populations can be explained by *people* and *place* factors. People factors mainly relate to personal characteristics

like education level, income, health, and demographics. Contrary, place factors concern characteristics from the environment, like pollution, infrastructure, and the job and housing market. Yet, the two factors are interrelated. For example, the lack of human capital and talent within a rural area can cause lower income and higher unemployment compared to an urban area (Burger et al., 2020).

Furthermore, urbanisation is considered a tool to achieve economic growth and increased living standards, which is expected to have a positive influence on happiness and life satisfaction. This expectation is based on the idea that it creates better job opportunities, higher wages, better accessibility, and lower costs to social participation (Burger et al., 2020). As a result, urban populations are often believed to give higher scores on their life evaluation than rural populations, which is also observed in figure 4 (Dijkstra & Papadimitriou, 2020). Yet, this observation does not seem to hold in all types of regions. Burger et al. (2020) found higher happiness levels for rural populations than for urban populations in Western countries. They argue that this is the result of a higher sense of community, lower housing prices, and more households with two or more persons. The same effect has been observed by Neira et al. (2018), who add to the discussion that this effect is more often observed for happiness than for life satisfaction. There, thus, remain heterogeneous views on happiness, life satisfaction, and urban-rural differentials.

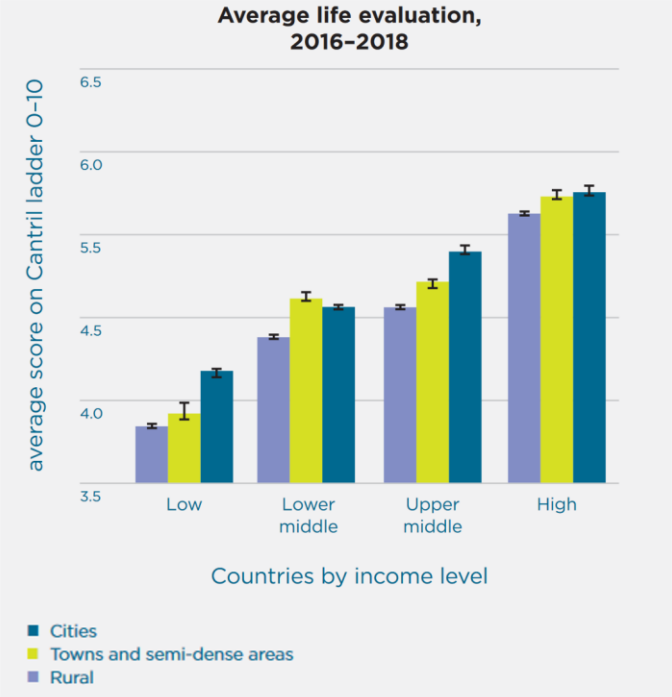

Figure 4. Life evaluation by Degree of Urbanisation and income level (Dijkstra & Papadimitriou, 2020)

2.5.1 Differences in social impact

Urban-rural differentials may be subject to differences in the effect of social impacts. In 1970, the first law of geography was introduced by Tobler: "Everything is related to everything else, but near things are more related than distant things" (Tobler, 1970). Based on Tobler's first law and additional empirical research, Rijnks et al. (2019) argue that an individual's happiness is more dependent on a reference group within a short distance than those who are over longer distances. This argument is supported by the finding that subjective well-being is more significantly influenced by relative income with increasing proximity of the reference group. Moreover, Knight & Gunatilaka (2010) argue that rural populations are, geographically speaking, more limited in their consideration as to who belongs to their reference group. Consequently, rural populations seem to be more affected by peers living close by compared to urban populations.

Furthermore, there have been found considerable differences regarding the effect of social capital on happiness between urban and rural areas as discussed in section 2.3.1. Rural areas are often assumed to be richer in social capital than urban areas (Helliwell et al., 2020; Sørensen, 2016), which is an important source of happiness (Ballas, 2013). However, there remains a discussion on the effect of social capital in urban and rural communities. Hofferth & Iceland (1998) found mixed results on the strength of social capital in urban and rural communities, and Dijkstra & Papadimitriou (2020) observed strong feelings of trust in urban areas. Thus, there is no straightforward conclusion on the effect of social impact on urban-rural differentials in happiness.

2.5.2 Amenities

Although the impact of micro- and macro-economic drivers of happiness, like household income and unemployment, has been studied in-depth, only in more recent years there has emerged an interest in the impact of spatial factors (Brereton et al., 2008). Environmental characteristics and the presence of amenities have been addressed. Yet, data limitations caused analysis to take place based on relatively aggregated geographical levels, e.g. the country level (see Rehdanz & Maddison, 2005; Welsh, 2002). Brereton et al. (2008) attempted to explain well-being and life satisfaction in relation to distances to spatial and environmental characteristics. The distance to certain locations has been used as a proxy for the impact of these characteristics. For example, the distance to a city is considered to be an amenity for services, while also being a disamenity due to noise pollution. Over the last decade, more and more data included disaggregate indicators, enabling a more thorough analysis on the neighbourhood and regional level (see Ettema & Schekkerman, 2016; Alcock et al., 2015; Kopmann & Rehdanz, 2013).

Cities are considered a place rich in jobs, shops and services, and other amenities, while rural areas do not possess such amenities or to a lesser extent (Burger et al., 2020). However, urban areas do not exclusively benefit from the advantages of such an amenity-rich environment; rural areas in the proximity of urban areas also enjoy these advantages, fostering job creation and economic growth. Rural areas on larger distances from urban cores experience relatively less economic growth over the same

period (Green, 2001). Distance from the rural area to a city, thus, determines possibilities for job commuting and access to urban amenities. If the distance between the rural area and a city reaches a certain threshold, job opportunities for rural people in cities are lost and the demand for urban amenities decreases. As a result, these effects increase the likelihood for a region to experience rural poverty, where remoteness causes spatial inequalities and a lack of amenities (Partridge & Rickman, 2008).

Furthermore, individuals' well-being is positively influenced by the accessibility of natural land and green space (Alcock et al., 2015; Kopmann & Rehdanz, 2013). Especially distance to nature is important to consider, where shorter distances are considered to positively affect happiness and life satisfaction (Brereton et al., 2008). However, there remain heterogeneous views on whether urban greenery and urban park have similar positive effects on well-being. Ettema & Schekkerman (2016) were not able to find a statistically significant relationship between greenery and well-being.

2.5.3 Geography of discontent

Next to individual happiness, it is also important to consider the happiness of other individuals. Regional differences in the happiness of people can be related to the political context within a region (Ballas, 2021). The UK has been found to be "one of the most interregionally unequal countries in the industrialised world" (McCann, 2020, p. 256). This view is supported by evidence based on OECD data which suggests that there are large regional disparities in productivity, having a negative impact on inclusiveness and social cohesion (Gal & Egeland, 2018). Such disparities oftentimes are the result of a centralised government where is little to no focus on the regionalities and can lead to a decrease in happiness (McCann, 2020; Dijkstra et al., 2020). Moreover, the poorest regions are believed to suffer most from austerity policies, especially after the Global Financial Crisis. This can lead to urban-rural differentials in outcomes for the geography of discontent (Koeppen et al., 2021). Unhappiness and discontent are characteristics of the disadvantaged, often rural, communities, resulting from a halt on economic growth and low productivity (Dijkstra et al., 2020; Rodriguez-Pose, 2018). Yet, McCann (2020) argues that the geography of discontent in the UK is not driven by differences between urban and rural regions. Urban areas can suffer as much from the disparities as rural areas. As a result, both urban and rural areas are in need of a decentralised government and economic growth. This enables policy based on a better understanding of regional dynamics (McCann, 2020; Jennings et al., 2018).

3 CONCEPTUAL FRAMEWORK

In recent years, the UK is confronted with relatively high income inequality (ONS, 2021; OECD, 2021), as well as spatial differences in happiness levels (ONS, 2020). To counter the negative effects of spatial inequalities, further scientific research on these phenomena is needed (Ma et al., 2018; Diener & Ryan, 2009). Although the relation between happiness and income inequalities has been studied in the past (see Easterlin, 1974; Boyce et al., 2010; Rijnks et al., 2019), there has only been a focus on urban-rural

differentials when studying the relationship between happiness and domains like social capital (see Helliwell et al., 2020; Sørensen, 2016; Hofferth & Iceland, 1998). The paucity of research studying the effect of urban-rural differentials on happiness within the domain of relative income heightens the importance of including this as a geographical context. This chapter presents the conceptual model and the hypotheses based on the current body of literature

3.1 Conceptual model

Based on the literature discussed in chapter 2, the conceptual model as presented in figure 5 has been constructed. The conceptual model shows key elements for this study, as well as their relationship to one another. In the middle, the Science of Happiness and its underlying distinction into happiness and quality of life can be found. The literature in section 2.1 has shown that there are differences between the objective and subjective elements of the Science of Happiness. On the left-hand side, the key drivers affecting happiness and quality of life can be found. The drivers are categorised into three groups: individual and household characteristics (see section 2.3), contextual characteristics (see section 2.3), and relative income (see section 2.4). These three groups have a joint effect on elements of the Science of Happiness. On the right-hand side, the geographical context of this study is presented. The literature in section 2.5 describes differentials found in individuals' valuation of life and happiness between urban and rural populations. Furthermore, the key drivers may be jointly affected by and may jointly affect the urban-rural differentials. Differences in, for example, domains of deprivation may affect the outcomes for urban and rural populations. Moreover, characteristics of urban and rural areas may affect social capital and the reference group. Together, these effects feed into the outcomes for happiness and quality of life.

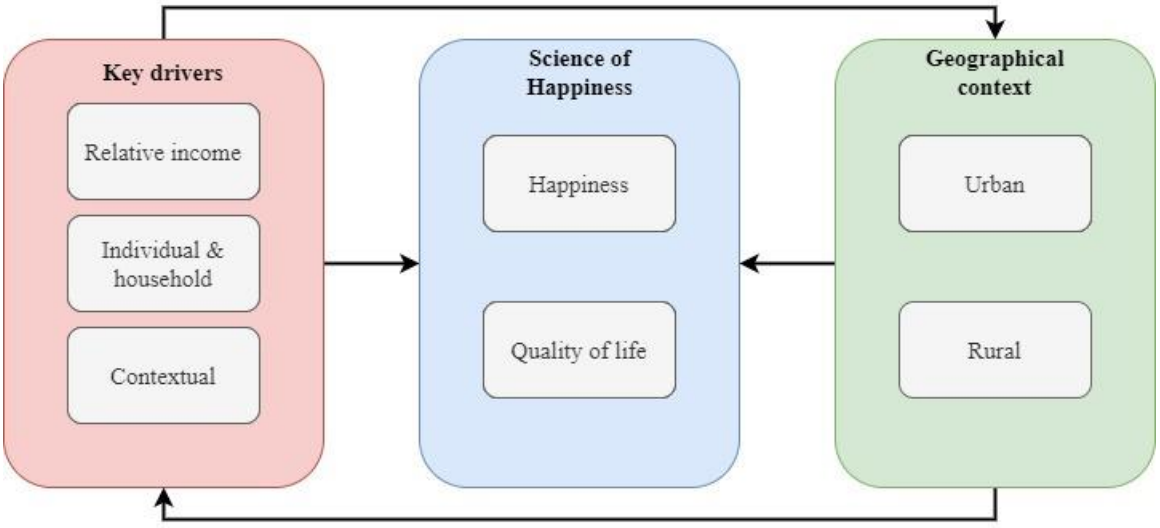

Figure 5. Conceptual model.

3.2 Hypotheses

This study aims to answer the following research question: "*To what extent is there a difference in the way relative income influences happiness of the urban and rural populations in England?*". Although the research question does not explicitly refer to it, this study aims to provide an overarching view by including a variety of domains within the field of happiness studies. Yet, there remains a focus on relative income and social comparison due to the relatively high income inequality in the UK. Furthermore, the application of urban-rural differentials contributes to the existing body of literature by providing a geographical context. By studying relative income, social comparison and urban-rural differentials, this study addresses the relative paucity of studies on these subjects. To answer the research question, a set of four sub-questions is constructed. Following the literature review, this section discusses the hypotheses and expectations for the sub-questions.

The first sub-question is: "*What are the main drivers of individuals' happiness according to the current body of literature?*". The literature discussed in chapter 2 revealed what is currently known in the literature. However, there is lacking an overarching view. Happiness is influenced by both individual and households drivers, and contextual drivers, which are discussed in section 2.2 and 2.3. The key individual and household drivers discussed in the literature are age, gender, education, employment, income, health, type of tenant, number of children, and marital status. Contextual drivers of happiness mostly concern social capital, the proximity of amenities, and the seven domains of deprivation. The theory explains the relationships between these drivers and happiness, which forms the basis for empirical analysis. This is also illustrated in the conceptual model in figure 5.

The second sub-question is: "*How does relative income influence happiness of individuals living in rural areas compared to those living in urban areas of England?*". Section 2.4 discussed the effect of absolute, relative and rank income on happiness. An explicit link was made to the effects of social comparison and income inequality on the relationship between income and happiness. Furthermore, section 2.5 provided a review on urban-rural differentials within this context. Already in 1970, Tobler introduced the first law of geography and argued that "near things are more related than distant things" (Tobler, 1970). Recently, Rijnks et al. (2019) studied the effect of distance on the influence of relative income on subjective well-being. Considering urban-rural differentials relating to the type of environment and population density, it is expected there is a significantly different effect of relative income on happiness between urban and rural populations. For this question, quantitative methods are employed using subjective well-being as a proxy for the happiness of individuals in England. The existing body of literature leads to the formulation of the following hypothesis:

> H_0: There is no difference in the effect of relative income on happiness of urban and rural populations in England.

H_1: There is a difference in the effect of relative income on happiness of urban and rural populations in England.

The third sub-question is: "*What difference can be observed for the effect of relative income between the subjective and objective measures of happiness for individuals in England?*". In the literature, a key distinction has been made between *quality of life* and *happiness*. This distinction is discussed into detail in section 2.1. Whereas quality of life includes objective measures, happiness studies focus on subjective measures (see Puntscher et al., 2015; Neira et al., 2018; Ziogas & Ballas, 2021). Or stated else, quality of life focuses on the outcomes, while happiness focusses on the process (Veenhoven, 2001). One may be satisfied with the outcome, while not happy with the process. Moreover, previous studies have found urban-rural differentials vary between happiness and life satisfaction (Burger et al., 2020; Neira et al., 2018). Further analysis examines whether there is found a difference in the relevance of relative income between *quality of life* and *happiness* studies. This sub-question helps to answer the research question by providing an insight into the differences and, in a later stage, enabling a discussion on this issue. Since relative income is partially based on the outcome of having a lower or higher income than another, as well as the subjective process of social comparison, there is no direct motive to expect that the effect of relative income differs between happiness and life satisfaction. However, it is expected that variables that are easier to define as either subjective or objective show discrepancies in their impact on happiness and life satisfaction.

The fourth sub-question is: "*How did the effect of relative income on happiness evolve over time in England?*". Section 2.5 described the relationship between income and happiness, known as the Easterlin Paradox. The Easterlin Paradox has shown that while income can increase over time, happiness does not increase with it as a result of social comparison (Easterlin & O'Connor, 2020; Easterlin, 1974). However, the increase in income inequality possibly has led to increasing effects of social comparison and the comparative utility hypothesis. This sub-question contributes to the study by enabling a comparison on the relevance of relative income between a selection of periods. As a result, one may be able to observe whether preferences shift. To answer this sub-question, the relationship between both absolute income and relative income with happiness is studied. It is expected that the data complies with the Easterlin Paradox, and thus that happiness does not increase over time if absolute income does so. Furthermore, it is expected that happiness increases if the relative income position of an individual improves. Although it was observed that income inequality overall has increased in the last 40 years, in more recent years there is a slight decrease (see figure 2). Therefore, it is expected that the impact of relative income decreases, especially for low-income individuals, since the relative position improved. A critical note herewith is that expectation depends on the extent to which happiness depends on the subjective process of social comparison, rather than the objective outcome of having increased relative income.

4 DATA AND METHODOLOGY

This chapter discusses the data and methodological choices made during this study. The use of the data and the operationalisation of variables within the data provides a framework within the analyses are interpreted in a later stage. Furthermore, this chapter elaborates on the types of analyses and the motivation for both quantitative and spatial techniques.

4.1 Data and study area

The main objective of this research is to study the extent to which relative income influences happiness of the urban and rural populations in England. With this, it is aimed to find out more about the drivers of happiness within a geographical context and to provide an overarching view on their impact. The observed regional differences in happiness and income in England (see figures 1 and 2) make the country an interesting case to study. Moreover, English rural areas are characterised by relatively large distances between people, whereas urban areas contrast this view (Dijkstra et al., 2020). This motivates the application of a geographical context in which urban-rural differentials are studies in more depth.

Figure 6 shows the study area, including the first impression of English regional patterns of subjective well-being. From the figure, it immediately becomes clear that there are only slight differences in the average score of subjective well-being between the governmental regions of England, ranging from 25.26 to 25.61 on a 36-point scale. Yet, on a lower spatial level and concerning urban-rural differentials, one might be able to find more drastic differences.

The analysis is largely based on data from the UK Understanding Society study (University of Essex, 2020), which has often been used in studies focusing on happiness and subjective well-being. It comprises a longitudinal questionnaire performed on a yearly basis since 2009, originating from the earlier published British Household Panel Survey. The study covers a broad spectrum of questions relating to demographic and socio-economic factors, with the aim to understand the experiences of the UK population. For the main analysis, the most recent version of the data set is used, which includes responses from 2019. In 2019, the questionnaire yielded 34,460 responses throughout the UK, of which a total number of 27,157 respondents live in England. After the process of data management and cleaning, a total of 21,589 observations were included in the analysis. Appendix A presents the steps taken during this phase.

To complement the individual data from the Understanding Society study, other contextual and regional data have been used and combined with the individual data to enrich the analysis. The complementary data has been combined with the Understanding Society data on the most disaggregated level possible, being on the level of governmental regions in England. Appendix B presents an overview of the complementary data included in this study. The application of the complementary data is discussed in more detail in section 4.3.

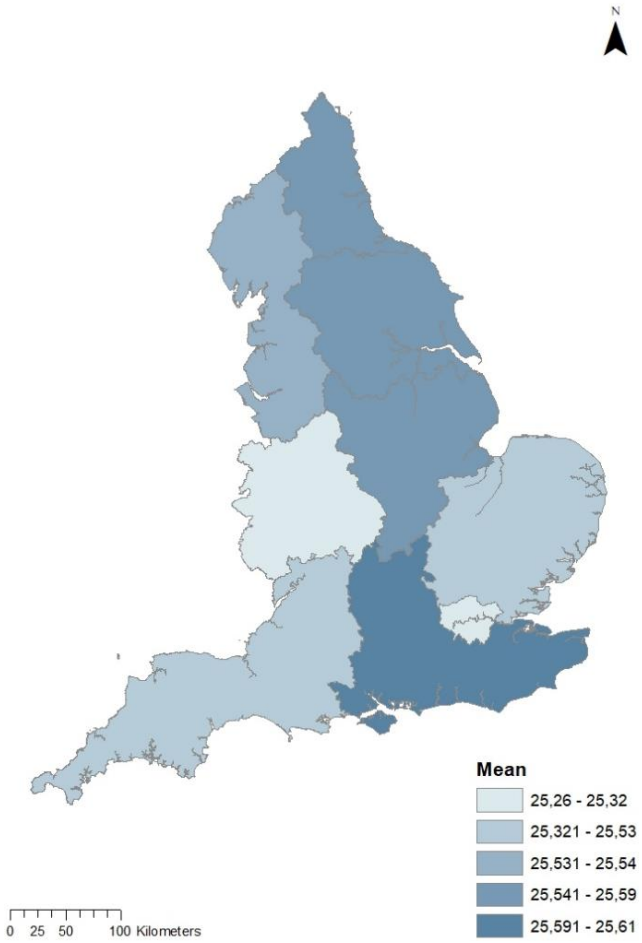

Figure 6. Average subjective well-being in English regions

4.2 Methodology

This study employs quantitative methods in a cross-sectional setting to analyse the influence of relative income on the subjective happiness of the urban and rural populations of England. The Understanding Society dataset comprises two key variables holding information on happiness: *subjective well-being* and *life satisfaction*. As discussed earlier, there are differences between the two proxies of happiness, although both have been used before in the literature as a means to estimate happiness. To differentiate between the concepts of *quality of life* and *happiness*, this study uses the methodological framework of Puntscher et al. (2015) as a basis. Here, quality of life is based on one's *life satisfaction*, whereas happiness is based on *subjective well-being*. The main analysis focuses on *subjective well-being* as the dependent variable to truly grasp the process-based nature within the Science of Happiness. Due to the interchanging use of life satisfaction and subjective well-being as a measurement of happiness, life satisfaction is used for further robustness analysis, after which differences between the proxies are discussed.

4.2.1 Subjective well-being

The variable *subjective well-being* is quite unique since it measures subjective well-being based on an underlying set of 12 questions of the General Health Questionnaire (GHQ). The 12 questions included in the variable are:

1. Have you recently been able to concentrate on whatever you are doing?
2. Have you recently lost much sleep over worry?
3. Have you recently felt that you are playing a useful part in things?
4. Have you recently felt capable of making decisions about things?
5. Have you recently felt constantly under strain?
6. Have you recently felt you could not overcome your difficulties?
7. Have you recently been able to enjoy your normal day-to-day activities?
8. Have you recently been able to face up to your problems?
9. Have you recently been feeling unhappy and depressed?
10. Have you recently been losing confidence in yourself?
11. Have you recently been thinking of yourself as a worthless person?
12. Have you recently been feeling reasonably happy all things considered?

The results of the GHQ are recoded to a single scale, after which the subjective well-being variable consists of a scale from 0, being the least distressed, to 36, being the most distressed. For intuitive reasons, the variable scale has been converted from 0 as most distressed to 36 as least distressed, and thus "least happy" to "most happy". Table 1 shows the summary statistics of the SWB variable.

In the literature, there are contesting views on how to treat the subjective well-being GHQ-12 variable. Since the variable is recoded based on a set of 12 underlying questions, the discussion mostly revolves around the question of whether this variable is continuous or categorical. Ferrer-i-Carbonell & Frijters (2004) have studied how one can treat similar types of variables and what different types of estimation techniques do to the outcomes of a study. A comparison between OLS and ordered logistic regression showed that coefficients only show slight differences in their size. The sign and significance of coefficients, and the coherence between variables showed similar results. As a result, the GHQ-12 variable is treated as a continuous variable, which makes OLS a fitting estimation technique.

Table 1. Summary statistics of the dependent variable Subjective well-being (GHQ-12)

Subjective well-being (GHQ)	Frequency	Percentage	Cumulative percentage
0	83	0.38	0.38
1	38	0.18	0.56
2	30	0.14	0.70
3	32	0.15	0.85
4	28	0.13	0.98
5	44	0.20	1.18
6	52	0.24	1.42
7	51	0.24	1.66
8	63	0.29	1.95
9	63	0.29	2.24
10	98	0.45	2.70
11	111	0.51	3.21
12	140	0.65	3.86
13	215	1.00	4.85
14	200	0.93	5.78
15	229	1.06	6.84
16	281	1.30	8.14
17	325	1.51	9.65
18	382	1.77	11.42
19	370	1.71	13.13
20	480	2.22	15.36
21	472	2.19	17.54
22	642	2.97	20.52
23	744	3.45	23.96
24	1,023	4.74	28.70
25	2,390	11.07	39.77
26	2,107	9.76	49.53
27	1,745	8.08	57.61
28	1,808	8.37	65.99
29	1,856	8.60	74.58
30	1,989	9.21	83.80
31	2,519	11.67	95.47
32	473	2.19	97.66
33	230	1.07	98.72
34	139	0.64	99.37
35	78	0.36	99.73
36	59	0.27	100.00
Total	21,589	100.00	

4.2.2 Life satisfaction

The variable *life satisfaction* is based on the question "How dissatisfied or satisfied are you with your life overall?". This is an ordinal variable consisting of seven categories, ranging from completely dissatisfied (1) to completely satisfied (7). Table 2 presents the summary statistics of the variable life satisfaction. Since this dependent variable is categorical, rather than continuous, linear regression models do not suit the data. Linear models like OLS assume linearity, normality, and homoscedasticity, which are problematic using a categorical dependent variable. Moreover, it should be considered that the real distance between categories is not known. As a result, a logistic model is advised (Mehmetoglu & Jakobsen, 2017).

Logistic models cover different types of logistic regressions, of which the three main types are (1) binary logistic regression, (2) multinomial logistic regression, and (3) ordered logistic regression. The binary logistic model uses a dichotomous dependent variable with categories like "yes" and "no", or "success" and "failure". The variable can, therefore, take the values of either 0 or 1. If the categorical dependent variable consists of three or more categories, other types of logistic models can be used. The multinomial logistic model assumes that there is no ordering between categories, while the ordered logistic regression uses the values of the variable to give the categories an order from low to high (Mehmetoglu & Jakobsen, 2017). An ordered logistic model would enable analysis on lower and higher outcomes for happiness. Furthermore, it would be possible to recode the ordinal dependent variable with three or more categories to a dichotomous variable, so that a binary logistic regression can be executed. However, the information about the ordering of the variable would be lost. Therefore, the preferred estimation technique for life satisfaction is an ordered logistic regression.

Table 2. Summary statistics of the dependent variable Life satisfaction

Life satisfaction	Frequency	Percentage	Cumulative percentage
(1) Completely dissatisfied	443	2.05	2.05
(2) Mostly dissatisfied	906	4.20	6.25
(3) Somewhat dissatisfied	1,943	9.00	15.25
(4) Neither satisfied nor dissatisfied	2,560	11.86	27.11
(5) Somewhat satisfied	4,067	18.84	45.94
(6) Mostly satisfied	9,429	43.68	89.62
(7) Completely satisfied	2,241	10.38	100
Total	21,584	100.00	

4.3 Operationalisation of the explanatory variables

This study aims to analyse the effects of relative income on happiness, where there is a focus on the difference between the urban and rural populations of England. Therefore, the key explanatory variables are relative income and an urban-rural indicator. Relative income represents the income of an individual relative to that of a reference group, which is not predefined by the definition of relative income (Boyce et al., 2010; Gerdtham & Johannesson, 2004). For this study, the relative income of respondents is based on the respondent's household income compared to the average governmental regional household income. This provides social comparison at the lowest possible geographical level given the data at hand. The difference between the household income and average income represents the relative income. A negative value indicates that the household earns below average, and a positive value indicates above-average income. Although it does not represent relative income on a very local scale (i.e., on neighbourhood level), the regional average does give a good impression of whether a respondent's income is considerably lower or higher than that of those who live in the area. For each respondent, the data includes information on whether the individual is located in an urban or rural part of the governmental region. The application of the geographical context of urban-rural in earlier research on happiness has shown considerable differences within a variety of domains (see Knight & Gunatilaka, 2010; Helliwell et al., 2020; Sørensen, 2016; Hofferth & Iceland, 1998; Dijkstra & Papadimitriou, 2020), creating a relevant setting for further research. In the Understanding Society dataset, a respondent is assigned 'urban' when the individual lives in a city or village with over 10,000 inhabitants. If the population is smaller than 10,000, the respondent is considered to live in a rural area. The population and classification are based on information from the Office for National Statistics Rural and Urban Classification of Output Areas.

To analyse whether there are any differences in the effects of relative income on happiness between the urban and rural population of England, an indicator of income is interacted with the urban-rural variable. The interaction helps us understand whether the urban-rural differentials affect the relationship between relative income and happiness. To be able to compare among different economic groups in the population, the population has been divided into five groups based on household income quintiles of 20 percent based on the rank-income hypothesis (see Boyce et al., 2010).

Next to these key independent variables, two other sets of explanatory variables are added to the model: individual and household demographic characteristics, and contextual characteristics. The individual and household demographic characteristics can be considered the control variables. The relevance of these variables is deducted from theory and the variables are often used in models to control for variance among respondents. Section 2.2 presented the individual and household attributes of happiness. On the individual demographic level, the U-shaped relationship between age and happiness, and the increasing effect of the female gender have been identified (see Ballas, 2013; Clarke, 2003; Blanchflower, 2020; Montgomery, 2016). The relevant household attributes are the, overall, negative effect of children, and the effect of different types of marital status and tenancy (see Alesina et al., 2004;

Angeles, 2010; Wadsworth, 2016; Foye et al., 2018; Rohe & Basolo, 1997). Furthermore, happiness can be affected by the individual attributes of education, employment, income, and health. Negative employment, the length of education, the height of absolute and relative income, and the absence of longstanding illnesses are important factors to consider (see Clark, 2003; Easterlin, 2012; Ballas, 2013; Cuñado & De Gracia, 2012; Blanchflower & Oswald, 2004; Ng & Diener, 2019; Pierewan & Tampubolon, 2015; Dolan et al., 2008). Based on findings on the relevance of these variables within the current body of literature, the above-stated variables are included in the model. The Understanding Society dataset holds all relevant information relating to the control variables.

The set of contextual variables consists of social capital and the Multiple Deprivation Index (MDI), which both represent an index scaled 0-100. The variable social capital reflects the trust that the individual has in his or her neighbours. Trust as an indicator of social capital reflects the sense of belonging, which contributes to life satisfaction. Results on trust in neighbours have the ability to inform policy to tackle social exclusion (Hoogerbrugge & Burger, 2018). The MDI presents a measurement of deprivation, as introduced in section 2.3.2. Since deprivation threatens happiness due to the consequences of social exclusion and shortcomings in resources (see Hick, 2016; Cuesta & Budría, 2014; Schneider et a., 2020), the MDI is an important contextual attribute to include in the model. The data for the contextual variables are not included in the Understanding Society dataset and, therefore, are included as complementary data on a regional scale. Appendix B provides information on the sources and their application.

Lastly, the effect of proximity to amenities is considered in the models. Two main amenities discussed in the literature are natural areas and city services. The distance to a city represents the presence of amenities, services, and jobs, which contribute to one's quality of life (Green, 2001). Furthermore, access to natural land and green space, especially within close distance, is found beneficial for one's well-being (see Alcock et al., 2015; Kopmann & Rehdanz, 2013; Green, 2001). Therefore, distances to London and distances to the nearest national park have been included to study the relevance of proximity to amenities. Section 4.6 describes the application of Geographical Information Systems to calculate the distances between regions and amenities.

Although the Understanding Society dataset includes individuals living throughout the UK, this study only focuses on England. The analysis presented in this study includes the Multiple Deprivation Index of England. Although this measurement is available in Wales, Scotland, and Northern Ireland as well, the results are non-comparable, and inclusion would lead to biased results (Ministry of Housing, Communities and Local Government, 2019). Therefore, Wales, Scotland, and Northern Ireland have been excluded from the analysis. Table 3 presents the summary statistics of the explanatory variables discussed above and included in the analysis.

Table 3. Summary statistics of the explanatory variables

Variable	Category	Mean	SD	Min	Max
Ln relative income		0.555	0.682	-7.300	3.242
Urban - rural	Urban (1 = yes)	0.800	0.400	0	1
	Rural (1 = yes)	0.200	0.400	0	1
Income quintile	Q1 (1 = yes)	0.200	0.400	0	1
	Q2 (1 = yes)	0.200	0.400	0	1
	Q3 (1 = yes)	0.200	0.400	0	1
	Q4 (1 = yes)	0.200	0.400	0	1
	Q5 (1 = yes)	0.200	0.400	0	1
Ln household income		8.023	0.682	0.223	11.044
Age		48.879	18.533	16	100
Age squared		2732.613	1859.201	256	10000
Longstanding illness	Yes (1 = yes)	0.351	0.477	0	1
	No (1 = yes)	0.649	0.477	0	1
Sex	Male (1 = yes)	0.445	0.497	0	1
	Female (1 = yes)	0.555	0.497	0	1
Marital status	Single (1 = yes)	0.302	0.459	0	1
	Married/cohabitation (1 = yes)	0.541	0.498	0	1
	Divorced (1 = yes)	0.103	0.305	0	1
	Widowed (1 = yes)	0.054	0.226	0	1
Employment	Self-employed (1 = yes)	0.083	0.276	0	1
	Employee (1 = yes)	0.501	0.500	0	1
	Unemployed (1 = yes)	0.037	0.188	0	1
	Retired (1 = yes)	0.240	0.427	0	1
	Family and home (1 = yes)	0.043	0.203	0	1
	Illness and disability (1 = yes)	0.030	0.170	0	1
	Other (1 = yes)	0.067	0.250	0	1
Education	Level 1 (1 = yes)	0.262	0.440	0	1
	Level 2 (1 = yes)	0.114	0.317	0	1
	Level 3 (1 = yes)	0.073	0.260	0	1
	Level 4 (1 = yes)	0.341	0.474	0	1
	Other (1 = yes)	0.211	0.408	0	1
Number of kids		0.545	0.932	0	6
Tenure	Owned outright (1 = yes)	0.349	0.477	0	1
	Owned mortgage (1 = yes)	0.397	0.489	0	1
	Public housing (1 = yes)	0.144	0.352	0	1
	Private rent (1 = yes)	0.110	0.313	0	1
Social capital index		63.738	3.787	56	68
Multiple Deprivation Index		21.696	4.431	15.48	28.15
Distance to London		169.380	123.487	0	409
Distance to national park		59.941	20.963	36	96
Number of observations		21,589			

4.4 Empirical model

This study aims to analyse the importance of relative income for happiness in England, comparing urban and rural populations. To achieve this, an Ordinary Least Squares (OLS) model is estimated. The following specification is relevant for the main analysis:

$$GHQ12_{i,k} = \alpha + \beta_1 * \ln relative\ income_i + \beta_2 * rural_i + \beta_3 * quintile_i + \beta_4 * rural_i * quintile_i + \sum_{k=1}^{K} \phi_k X_{i,k} + \varepsilon_{i,k}$$

where $GHQ12_{i,k}$ represents the subjective well-being score of individual *i* in location *k*. α represents the constant and β represents the estimated coefficient for the relevant independent variable. The log of relative income consists of the difference between the regional household income and the household income of the individual, taken by its natural logarithm. The variable *rural* is a dummy variable indicating whether individual *i* is located in a rural area or not, where the variable is given the value of 1 if located in a rural area. The variable *quintile* holds five categories, each representing 20 percent of the total population based on the height of their household income. The variables *rural* and *quintile* are interacted to identify whether there is a difference in happiness found between the urban and rural population based on their rank income. $X_{i,k}$ represents a set of individual, household, and contextual characteristics affecting subjective well-being. $\varepsilon_{i,k}$ represents the error term. The coefficients which are estimated by the model are, thus, α, $\beta_{1,2,3,4}$, and ϕ_k.

In earlier studies on happiness, it has been advised to include individual fixed effects into the analysis to remove any disturbance caused by cross-region differences (Ferrer-i-Carbonell & Frijters, 2004). However, since the complementary data is based on regional differences, the inclusion of additional location fixed effects would lead to high levels of collinearity. Therefore, it has been decided to not include these fixed effects in the model.

4.5 Diagnostic testing

To ensure that the model provides correct coefficients and residuals, the model is tested on the assumptions of homoscedasticity, multicollinearity, normally distributed residuals, and influential cases.

Firstly, the assumption of homoscedasticity suggests that there should be constant variance in the error term. The Breusch-Pagan test provides significant results if this assumption is violated. Secondly, the Variance Inflation Factors shows whether there is multicollinearity to be found in the model, causing problems with standard errors, and identifying the source of explanatory power. Thirdly, to be able to make valid generalisations based on the statistical outcomes, the errors have to be normally distributed. The distribution of the residuals is analysed to determine if this assumption is violated or not. Lastly,

the results of Cook's distance tells whether there are influential cases or outliers that cause disturbance in the outcomes of the model. The findings of the diagnostic testing are discussed in chapter 5.

4.6 Application of Geographical Information Systems

To enrich the analysis with variables based on spatial information, GIS is used to define explanatory variables based on the distance to a specific location. Such spatial explanatory variables have the ability to explain part of the variance found in the dependent variable. Spatial variables capture the potential importance of location for the perceptions of individuals. Preferably, spatial data is included on a very disaggregated level, such as the neighbourhood level. Yet, data on the individual or household may only include locational information on the neighbourhood or regional level. This has also been the case for this study, where only regional locational information was known. In that case, the centroid of a region can be used as a reference location to determine the effect of spatial variables. As a result, measurement error should be considered (Brereton et al., 2008). Using ArcGIS, the distances from regional centroids to amenities, being London and national nature parks, have been measured based on the centroids found in figure 7. After completing measurements, the gathered data has been imported into Stata for statistical analysis.

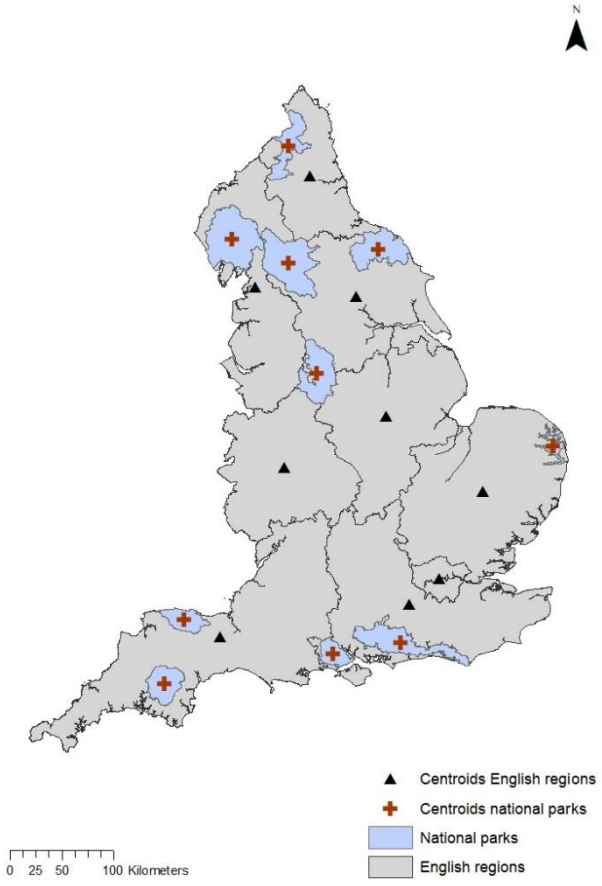

Figure 7. Centroids of English regions and national parks

4.7 Estimation strategy

The aim of this study is to find the effect of relative income on happiness of individuals in England, making a distinction between urban and rural populations. The first model includes the key independent variables to provide a first impression of the relation. Secondly, individual and household characteristics are included to control for socio-demographic factors. Thirdly, contextual variables enter the model to provide a better understanding of regional characteristics. Lastly, spatial variables are included to capture the effect of locations and amenities. After discussing the complete model, further analysis is presented. This further analysis consists of robustness checks of the dependent variable and other yearly waves of the data.

5 RESULTS

This chapter presents and interprets the results of the quantitative analysis. The first section discusses the OLS estimation results, after which the validation of the model is addressed. The last section provides two types of robustness checks, testing for changes in the dependent variable and different survey years.

5.1 OLS estimation results

Table 4 reports the key coefficients and robust standard errors of four specifications. The table reports the key variables for the analysis; the remaining coefficients can be found in Appendix C. The model is built in four steps. Model 1 presents the baseline model which is restricted to the key variables and their interactions. The coefficient for the log of relative income is positive and significant at a 5 percent significance level. This suggests that subjective well-being increases by 0.297 with every unit increase of the log of relative income, or that a 1 percent increase in relative income increases subjective well-being by 0.297 points. All of the coefficients of the interaction between the urban-rural dummy variable and the income quintiles are positive, but the model only finds a significant coefficient for the highest income quintile. This suggests that individuals living in a rural area and finding themselves in the highest income quintile report significantly higher subjective well-being of 0.517 compared to urban middle-income individuals. Furthermore, urban low-income individuals report lower subjective well-being of 0.385 compared to urban middle-income peers, which is statistically significant at a 5 percent level, compared to urban middle-income individuals. For the other quintile and urban-rural coefficients, no significant effect has been found in model 1.

In model 2, individual and household characteristics have been controlled for. The coefficient size and significance of a number of variables changes. For the key variables, the estimation results show significant coefficients for both the fourth and fifth income quintile interacted with the urban-rural dummy. Rural individuals in the fourth income quintile score 0.462 higher on subjective well-being than urban middle-income individuals, which is statistically significant at a 10 percent significance level. For

rural individuals in the fifth income quintile, this effect has the size of 0.667 compared to urban middle-income individuals and is significant at a 5 percent level. The log of relative income became statistically insignificant.

After controlling for individual and household characteristics, model 3 includes contextual characteristics. The social capital index measures whether individuals trust their neighbours. This variable has a positive sign but is not significant. Furthermore, the coefficient of the interaction variable remained almost constant. This model provides a significant coefficient of -0.266 at a 10 percent level for the fifth income quintile. This implies that urban individuals in the highest income quintile experience a decrease in subjective well-being of 0.266 compared to their middle-income peers. Moreover, rural individuals in the fifth income quintile score 0.411 (0.677 – 0.266) higher on subjective well-being compared to urban middle-income individuals, which is statistically significant at a 5 percent level. Rural individuals in the fourth income quintile score slightly higher on subjective well-being compared to urban middle-income individuals with 0.462, which is statistically significant at a 10 percent level. Furthermore, the Multiple Deprivation Index has been included in model 3, which has a positive sign and is significant at a 5 percent level. A higher outcome for MDI suggests that a region scores better on deprivation, which means that the region is less deprived. The positive sign of MDI shows that living in less deprived regions positively affects subjective well-being. A one-unit increase in MDI increases subjective well-being by 0.0334.

The last step, model 4, includes distances to London and distance to the closest national park in the specification. The coefficients for both variables have a negative sign, suggesting that living at an increasing distance of the city and natural amenities lowers subjective well-being. Although the signs are negative as expected, the variables do not have a statistically significant effect on subjective well-being. The coefficients and their significance of the interaction variables remained relatively stable in comparison to models 2 and 3. In this full model, rural individuals in the fourth income quintile score 0.464 higher on subjective well-being than urban middle-income individuals, which is statistically significant at a 10 percent level. For rural individuals in the fifth income quintile, this effect has the size of 0.675 compared to urban middle-income individuals and is significant at a 5 percent level. No significant difference is found between rural and urban middle-income individuals. Furthermore, MDI does not show a statistically significant effect, contrary to what was observed in model 3.

The adjusted R-squared presents how well the models fit the data. Model 1 shows that only 0.466 percent of the variance in the dependent variable is explained when including the key variables. The inclusion of the individual and households characteristics as control variables causes a considerable increase in the adjusted R-squared, where 12.8 percent of the variance is explained. Yet, the inclusion of contextual and spatial variables does not lead to a large increase in the explained variance. Although model 4 explains only 12.9 percent of the observed variance in the dependent variable, models on happiness oftentimes are faced with relatively low explanatory power (see for example Brereton et al., 2008; Ettema & Schekkerman, 2016).

Table 4. OLS regression results

Variable	Category	Model 1	Model 2	Model 3	Model 4
Log relative income		0.297**	0.187	-0.430	0.109
		(0.119)	(0.222)	(0.369)	(0.773)
Urban rural (ref = urban)		0.186	-0.262	-0.215	-0.219
		(0.207)	(0.196)	(0.197)	(0.197)
Quintile (ref=3)	1st Q	-0.385**	-0.0293	-0.0309	-0.0358
		(0.186)	(0.183)	(0.183)	(0.184)
	2nd Q	-0.169	-0.123	-0.128	-0.129
		(0.144)	(0.136)	(0.136)	(0.136)
	4th Q	0.0196	-0.121	-0.121	-0.119
		(0.138)	(0.133)	(0.133)	(0.133)
	5th Q	-0.0355	-0.259	-0.266*	-0.260
		(0.159)	(0.161)	(0.161)	(0.161)
Rural*Quintile (ref=urban+Q3)	R*1st Q	0.292	0.0716	0.0757	0.0702
		(0.323)	(0.298)	(0.299)	(0.299)
	R*2nd Q	0.469	0.366	0.372	0.369
		(0.292)	(0.271)	(0.272)	(0.272)
	R*4th Q	0.307	0.462*	0.462*	0.464*
		(0.282)	(0.270)	(0.270)	(0.270)
	R*5th Q	0.517*	0.667**	0.677**	0.675**
		(0.281)	(0.267)	(0.268)	(0.268)
Social capital index				0.0123	-0.0166
				(0.0138)	(0.0202)
Multiple Deprivation Index				0.0334**	0.0174
				(0.0138)	(0.0203)
Distance to London					-0.000167
					(0.00132)
Distance to national park					-0.00531
					(0.00372)
Constant		25.35***	24.20***	18.09***	24.69***
		(0.120)	(1.905)	(3.742)	(7.045)
Control variables included		No	Yes	Yes	Yes
Observations		21,589	21,589	21,589	21,589
Adjusted R-squared		0.00466	0.128	0.129	0.129

Note: The dependent variable is subjective well-being as GHQ-12 variable. Robust standard errors are given in parentheses. Other coefficients and control variables can be found in Appendix C. *** p < 0.01, ** p < 0.05, * p < 0.1.

The results of the OLS regression help to answer the following sub-question: "*How does relative income influence happiness of individuals living in rural areas compared to those living in urban areas of England?*". The null-hypothesis was formulated as follows: "There is no difference in the effect of relative income on happiness of urban and rural populations in England". The outcomes for the

interaction term in the fourth model help to answer this question. As discussed above, the coefficients of the fourth and fifth income quintile interacted with the urban-rural variable are statistically significant at, respectively, a 10 and 5 percent level. Therefore, the null-hypothesis for these interaction terms can be rejected. In other words, we reject that there is no difference in the effect of relative income on happiness of urban and rural populations in England. A critical note herewith is that this finding does not go for the two lowest income quintiles. To conclude, the influence of relative income is significantly different for high-income individuals living in rural areas compared to middle-income individuals living in urban areas.

5.2 Validation of the model

To ensure that the estimated coefficients and residuals of the model are trustworthy, the OLS assumptions discussed in Section 4.5 are tested. These are the assumptions of homoscedasticity, multicollinearity, normally distributed residuals, and influential cases.

The Breusch-Pagan test for heteroscedasticity was found to be significant, implying that there are problems with heteroscedastic error terms. This can cause bias in the correctness of the standard errors. To relax the assumption of heteroscedasticity, robust standard errors have been used for the OLS estimation. This provides more trustworthy standard errors in the model.

To test for normality of the residuals, the results have been plotted and detailed summary statistics have been considered (see Appendix D). The distribution of the residuals is approximately normally distributed, with slight skewness. However, the large sample relaxes the importance of normally distributed errors and no skewness. Therefore, this is not considered to be an issue.

Appendix E presents the VIFs and tolerance values for the variables included in the models. The variable *distance to London* shows a problematic VIF, which seems to stem from rather a high correlation with the MDI variable of 0.7 and the characteristics of regional macro drivers. The fourth model was, therefore, executed with and without *distance to London* to study the effects of the variable. This resulted in only minor changes in the coefficients. Therefore, the inclusion of this variable is accepted.

Lastly, Cook's test indicated that there are no influential cases within the sample which find themselves above the cut-off.

5.3 Robustness analysis

In this section, further analyses are presented to test the robustness of the regression results from the previous section. The first robustness test performed is an alternative specification to the OLS model. Life satisfaction is used as the dependent variable, with which an ordered logistic model is estimated. This enables a discussion on the differences between a subjective and objective dependent variable. After this, the OLS specification is used to analyse data from four waves including data from 2010,

2013, 2016, and 2019. This second robustness test presents possible changes in the relevance of relative income for happiness over the past decade.

5.3.1 Life satisfaction as a proxy for happiness

Life satisfaction is a categorical variable with seven categories ranging from completely dissatisfied to completely satisfied. Although the estimation method changes due to the categorical characteristics of this variable, the set of explanatory variables remains similar to those included in the OLS estimation. As discussed in section 4.2.2, an ordered logistic regression is used as an estimation technique. The categorised nature of the variable and the use of an ordered logistic model causes the model to have six cut points. The cut points of the ordered logistic model can be expressed as:

$$y_i = \begin{cases} Completely\ dissatisfied \\ Mostly\ dissatisfied \\ Somewhat\ dissatisfied \\ Neither\ satisfied\ nor\ dissatisfied \\ Somewhat\ satisfied \\ Mostly\ satisfied \\ Completely\ satisfied \end{cases} = \begin{cases} 1 & \text{if } y^* \leq \theta_1 \\ 2 & \text{if } \theta_1 < y^* \leq \theta_2 \\ 3 & \text{if } \theta_2 < y^* \leq \theta_3 \\ 4 & \text{if } \theta_3 < y^* \leq \theta_4 \\ 5 & \text{if } \theta_4 < y^* \leq \theta_5 \\ 6 & \text{if } \theta_5 < y^* \leq \theta_6 \\ 7 & \text{if } \theta_6 < y^* \end{cases}$$

As *life satisfaction* is estimated using ordered logistic regression, the empirical model needs to be adapted to allow for the estimation of odds and/or probabilities. Therefore, the following specification is used to estimate *life satisfaction*:

$$\ln\left(\frac{p}{1-p}\right) = \beta_1 * \ln relative\ income_i + \beta_2 * rural_i + \beta_3 * quintile_i + \beta_3 * rural_i * quintile_i + \sum_{k=1}^{K} \phi_K X_{i,k} + \varepsilon_i$$

where p represents the probability of an outcome within a specific category as presented above by the cut points. β represents the estimated coefficient for the relevant independent variable. The log of relative income consists of the difference between the regional household income and the household income of the individual, taken by its natural logarithm. The variable *rural* is a dummy variable indicating whether individual *i* is located in a rural area or not, where the variable is given the value of 1 if located in a rural area. The variable *quintile* holds five categories, each representing 20 percent of the population based on their household income. The variables *rural* and *quintile* are interacted to identify whether there is a difference in happiness found between the urban and rural population based on their rank income. $X_{i,k}$ represents a set of individual, household, and contextual characteristics affecting subjective well-being. $\varepsilon_{i,k}$ represents the error term. The coefficients which are estimated by the model are, thus, $\beta_{1,2,3,4}$, and ϕ_k.

The literature differentiates between *quality of life* and *happiness* studies within the field of Science of Happiness. It was found that quality of life focuses on objective outcomes, whereas happiness focuses on subjective processes (see Puntscher et al., 2015; Neira et al., 2018; Ziogas & Ballas, 2021). As a result, the input of the drivers may lead to different results for quality of life and happiness of individuals. To analyse whether such differences can be found in England, the OLS regression has been used as a basis to perform an ordered logistic regression using *life satisfaction* as the dependent variable. Table 5 reports the key coefficients and standard errors of four specifications similar to those of the OLS estimation. An ordered logistic regression is used to analyse the categorical variable Life Satisfaction. The table reports the key variables for this analysis; other coefficients can be found in Appendix F.

Model 5 presents the baseline specification with the key variables. The log of relative income is found to be positive and significant. A one-unit increase of the log of relative income leads to a 0.145 increase in the log-odds of life satisfaction, which is statistically significant at a 1 percent level. Or stated differently, a 1 percent increase in relative income increases the odds of life satisfaction by 0.145 percent, where 0.145 presents the elasticity of life satisfaction with respect to relative income. Furthermore, individuals in the lowest income quintile and living in an urban area experience a decrease in the log-odds of life satisfaction of 0.0958 compared to urban individuals in the middle-income quintile, which is statistically significant at a 10 percent level. Individuals in the highest income quintile experience and living in an urban area an increase in the log-odds of life satisfaction of 0.114 compared to urban middle-income individuals, which is statistically significant at a 5 percent level. Next to this, the log-odds of life satisfaction of middle-income individuals living in a rural area is 0.126 higher than that of urban middle-income individuals. This coefficient is significant at a 10 percent level. When considering the interaction between the income quintiles and the urban-rural dummy, it can be seen that individuals in the fifth income quintile and living in a rural area experience a significant increase of 0.397 (0.157 + 0.126 + 0.114) in the log-odds of life satisfaction compared to urban middle-income individuals.

The specification of model 6 includes the individual and household control variables. The inclusion of the control variable mostly impacts the size of the key variables. The log of relative income is positive and significant at a 1 percent level, of which a one-unit increase leads to an increase of 0.298 in the log-odds of life satisfaction. Contrary to model 5, the urban-rural dummy is not significant anymore. However, an increase of 0.116 in the log-odds of life satisfaction is observed for urban individuals in the highest income quintile compared to urban individuals in the middle-income quintile, which is statistically significant at a 5 percent level. The interaction between the urban-rural dummy and the highest income quintile is positive and is significant at a 5 percent level. This finding suggests that when someone finds him or herself within this category, the log-odds of life satisfaction increases by 0.324 (0.116 + 0.208) compared to that of an urban middle-income individual.

The inclusion of contextual characteristics in model 7 does not seem to have a large impact on the coefficients in the model. The outcomes for the coefficients of both the log of relative income and the interaction between urban-rural and income quintiles remain very stable. Rural individuals in the fifth income quintile score 0.317 (0.195 + 0.122) higher on the log-odds of life satisfaction than urban middle-income individuals, which is statistically significant at a 5 percent significance level. In Appendix F it can be observed that this is also the case for the coefficients of the control variables. Furthermore, the variable social capital is positive and statistically significant on a 5 percent level, where the coefficient implies that a one-unit increase in social capital leads to an increase of 0.00924 in the log-odds of life satisfaction. The MDI variable does not have a statistically significant outcome in this model.

Model 8 includes the distance to London and the distance to the nearest national park for the respondents. The log of relative income remained positive and is significant at a 10 percent level. A one-unit increase in the logarithm of relative income leads to an increase of 0.502 in the log-odds of life satisfaction. Again, the interaction variable between the urban-rural dummy and income quintiles remained very stable with only some minor changes in the coefficients. Rural individuals in the fifth income quintile score 0.319 (0.194 + 0.125) higher on the log-odds of life satisfaction than urban middle-income individuals, which is statistically significant at a 5 percent significance level. Social capital is not significant anymore after the inclusion of the distance variables, while MDI now is significant at a 10 percent level. However, the sign of the coefficient is very unexpected. The model indicates that a one-unit increase in MDI, suggesting that a region is less deprived, has a negative effect of 0.0124 on the log-odds of life satisfaction. Furthermore, the distance to the nearest national park is negative and significant at a 10 percent level. This suggests that a one-unit increase in distance to the nearest national park leads to a decrease of 0.00255 in the log-odds of life satisfaction. The distance to London does not give statistically significant results.

Reflecting on the goodness-of-fit, model 5 shows that 0.357 percent of the variance in the dependent variable is explained when including the key variables. Model 6 shows an increase of the pseudo R-squared, where 4.22 percent of the variance is explained by the model. Similar to the OLS model, the pseudo R-squared shows only a slight increase after the inclusion of contextual (model 7) and spatial (model 8) variables. Similar to the OLS model, ordered logistic regressions analysing happiness and life satisfaction typically show relatively low pseudo R-squared results.

Using the findings of the ordered logistic model, the third sub-question can be answered: "*What difference can be observed for the effect of relative income between the subjective and objective measures of happiness for individuals in England?*". The results of model 4 in table 4 and model 8 in table 5 are compared to answer this question. In model 4, statistically significant coefficients were observed for the fourth and fifth income quintile interacted with the urban-rural variable. This led to the conclusion that rural individuals in the fourth and fifth income quintile report significantly higher scores on their happiness, of respectively 0.464 and 0.675. However, such differences were not observed comparing urban middle-income populations and rural middle- and low-income populations with each

other. Model 8 provides a statistically significant coefficient for the fifth income quintile interacted with the urban-rural variable. Rural high-income individuals were found to experience significantly higher life satisfaction of 0.319 compared to urban middle-income individuals. To conclude, there is a significant difference in the effect of relative income on the happiness of rural individuals in the highest income group compared to urban middle-income individuals.

Table 5. Proportional Odds regression results

Variables	**Categories**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Log relative income		0.145***	0.298***	0.273**	0.502*
		(0.0369)	(0.0733)	(0.124)	(0.267)
Urban rural (ref = urban)		0.126*	-0.0206	-0.0340	-0.0366
		(0.0676)	(0.0686)	(0.0689)	(0.0689)
Quintile (ref=3)	1st Q	-0.0958*	-0.0891	-0.0888	-0.0901
		(0.0570)	(0.0626)	(0.0626)	(0.0626)
	2nd Q	-0.0314	-0.0535	-0.0519	-0.0515
		(0.0454)	(0.0467)	(0.0467)	(0.0467)
	4th Q	0.0650	0.0530	0.0534	0.0540
		(0.0450)	(0.0462)	(0.0462)	(0.0462)
	5th Q	0.114**	0.116**	0.122**	0.125**
		(0.0515)	(0.0562)	(0.0562)	(0.0562)
Rural*Quintile (ref=urban+Q3)	R*1st Q	0.151	0.0787	0.0794	0.0767
		(0.102)	(0.103)	(0.103)	(0.103)
	R*2nd Q	0.151	0.144	0.143	0.142
		(0.0983)	(0.0989)	(0.0989)	(0.0989)
	R*4th Q	0.0715	0.128	0.125	0.126
		(0.0949)	(0.0960)	(0.0960)	(0.0960)
	R*5th Q	0.157*	0.208**	0.195**	0.194**
		(0.0949)	(0.0961)	(0.0962)	(0.0962)
Social capital index				0.00924**	-0.00567
				(0.00471)	(0.00701)
Multiple Deprivation Index				-0.00293	-0.0124*
				(0.00470)	(0.00709)
Distance to London					2.60e-05
					(0.000464)
Distance to national park					-0.00255*
					(0.001307)
Control variables included		No	Yes	Yes	Yes
Observations		21,584	21,584	21,584	21,584
Pseudo R-squared		0.00357	0.0422	0.0423	0.0425

Note: The dependent variable is life satisfaction. Standard errors are given in parentheses. Other coefficients and control variables can be found in Appendix F. *** p < 0.01, ** p < 0.05, * p < 0.1.

5.3.2 The relevance of relative income over the years

To find whether changes in the effect of relative income on happiness have taken place over the years, four different waves of the Understanding Society dataset have been analysed. Wave A comes from 2010, Wave D from 2013, Wave G from 2016, and Wave J from 2019. Furthermore, Appendix B presents the complementary data used for the different years. For each analysis, the empirical model as presented in Section 4.4 has been used for the estimation of the coefficients.

The analysis of waves over time enables a simplified version of the Easterlin Paradox, which describes the relationship between happiness and relative income over time. It is the income of an individual relative to the individual of another at a specific time that affects happiness, rather than the progression of absolute income over time. To confirm whether this paradox is true for this study, figure 8 presents the progression of subjective well-being and household income in England throughout 2010 to 2019. The graph can be used to describe the relationship between happiness, on the left-hand side, and income, on the right-hand side. Since 2010, the average absolute income has been rising from approximately £2,800 to £3,800. Contrary, subjective well-being fluctuated between approximately 25.5 and 25.9 on the 36-point GHQ-12 scale. Thus, the trend of increasing income was not followed by a similar trend for subjective well-being in England during 2010-2019. This shows that the relationship between happiness and income in England behaves as one may expect based on the Easterlin Paradox.

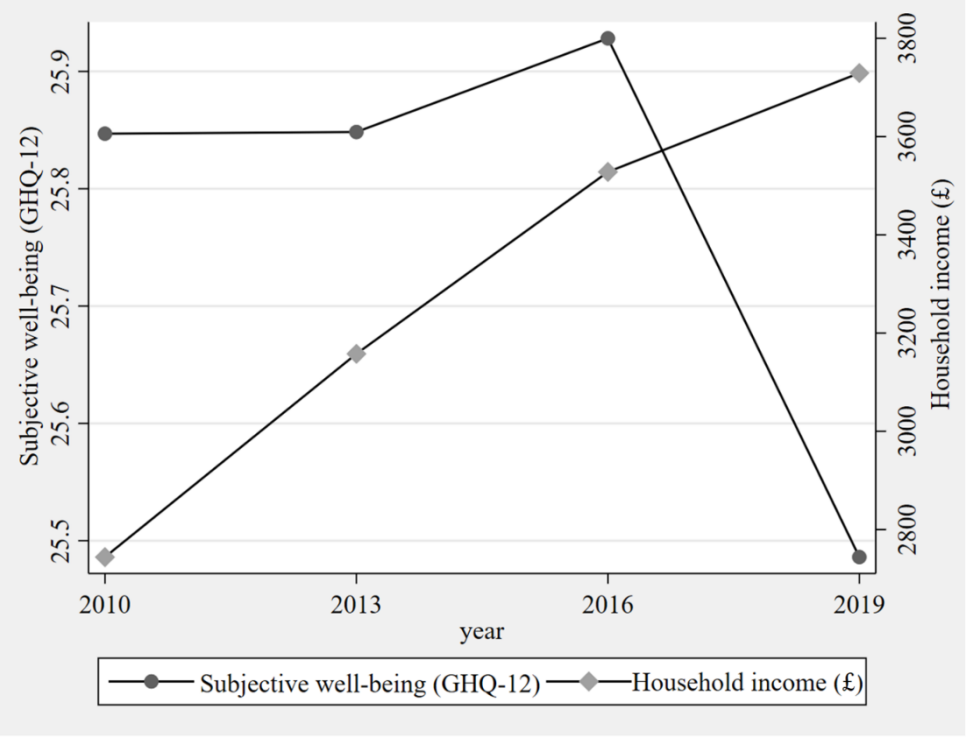

Figure 8. Progression of subjective well-being and household income 2010-2019

To further analyse the effects of relative income over the period 2010-2019, the OLS model 4 as presented in table 4 has been repeated for the years 2010, 2013, and 2016. Table 6 presents the coefficients for the key variables. Other coefficients can be found in the full model in Appendix G.

Interestingly, the results of the different waves suggest that there is not one overarching determinant of relative income which significantly affects happiness. Model 9 suggests that the log of relative income had a statistically significant effect on happiness based on a 1 percent significance level. During this wave, one unit increase in the log of relative income led to an increase of 2.497 in subjective well-being. However, no significant effect has been found for the log of relative income for the subsequent models. Furthermore, no statistically significant effect is found for either of the interaction terms between the urban-rural dummy and the income quintiles for model 9, although the other models do show significant differences for one or more of the interaction terms. Also, the effect of contextual variables such as the MDI and distances show variations in the significance of the effect on happiness. Yet, social capital has not had a significant effect on either one of the waves.

The results of model 11 for the interaction terms are noteworthy. Based on the coefficients of the interaction between the urban-rural dummy and the income quintiles, urban individuals in both the low- and high-income quintiles were found to experience significantly higher subjective well-being than urban middle-income individuals. This is the only model for which a significant contribution of the interaction term was found. In the other models, no significant differences in subjective well-being were found between rural low-income individuals and urban middle-income individuals.

Based on the regression results as presented in table 6, it is not possible to conclude that there is a specific trend in the way the relevance of relative income for happiness in England has evolved over the years. To clarify the interpretation of these results, table 7 presents the total effects of the interaction term and its main effects during the period 2010-2019, where urban middle-income functions as the reference group. Over the years, the significance of the interaction term shows major changes. Whereas no significant difference was found for either of the income quintiles in 2010 (model 9), all income quintiles showed significant differences in 2016 (model 11).

The adjusted R-squared over time shows some fluctuations, although this stayed within the range between 10.8 and 12.9 percent. This indicates that the different models did not lose or gain relatively large explanatory power concerning data over four separate years.

The results of models 9 to 12 help to answer the fourth sub-question: "*How did the effect of relative income on happiness evolve over time in England?*". In the past, the effect of income on happiness has been described by the Easterlin Paradox. The Easterlin Paradox has shown that while income can increase over time, happiness does not increase with it as a result of social comparison (Easterlin & O'Connor, 2020; Easterlin, 1974). As expected, this phenomenon has also been observed for the case of England, which is reflected in figure 8. However, this only shows the relationship between absolute income and happiness. To better understand the effect of relative income on happiness over time, four waves from the period 2010-2019 have been studied. From the analysis, it can be concluded that the

relevance of relative income has changed over time. Whereas in 2010 (model 9) no significant difference between urban and rural populations has been found, in 2016 (model 11) both lower- and higher-income individuals living in rural areas reported significantly higher happiness compared to urban middle-income individuals. Therefore, the effect of relative income on happiness over time is rather inconclusive.

Table 6. Wave A, D, G, and J OLS estimation results of subjective well-being

Variable	Category	Model 9 (A)	Model 10 (D)	Model 11 (G)	Model 12 (J)
Log relative income		2.497***	-0.0136	-1.262	0.109
		(0.912)	(0.0568)	(0.805)	(0.773)
Urban rural (ref = urban)		0.00327	0.445**	-0.410**	-0.219
		(0.161)	(0.181)	(0.192)	(0.197)
Quintile (ref=3)	1st Q	-0.231	0.0356	-0.160	-0.0358
		(0.150)	(0.183)	(0.176)	(0.184)
	2nd Q	-0.202*	0.0248	-0.241*	-0.129
		(0.112)	(0.132)	(0.127)	(0.136)
	4th Q	0.0841	0.254**	-0.154	-0.119
		(0.103)	(0.128)	(0.124)	(0.133)
	5th Q	0.150	0.179	-0.155	-0.260
		(0.125)	(0.162)	(0.157)	(0.161)
Rural*Quintile (ref=urban+Q3)	R*1st Q	0.190	-0.414	0.589**	0.0702
		(0.243)	(0.278)	(0.279)	(0.299)
	R*2nd Q	0.149	-0.252	0.812***	0.369
		(0.231)	(0.253)	(0.272)	(0.272)
	R*4th Q	0.0881	-0.461*	0.972***	0.464*
		(0.217)	(0.247)	(0.253)	(0.270)
	R*5th Q	0.232	-0.367	0.935***	0.675**
		(0.205)	(0.242)	(0.250)	(0.268)
Social capital index		-0.0250*	0.00485	-0.0122	-0.0166
		(0.0139)	(0.0116)	(0.0200)	(0.0202)
Multiple Deprivation Index		-0.00597	-0.0123*	-0.0136	0.0174
		(0.00565)	(0.00628)	(0.0190)	(0.0203)
Distance to London		-0.00249***	0.000589	0.00158	-0.000167
		(0.000924)	(0.000629)	(0.00135)	(0.00132)
Distance to national park		-0.0156***	-0.00353*	-0.00126	-0.00531
		(0.00320)	(0.00213)	(0.00381)	(0.00372)
Constant		48.43***	23.56***	15.58**	24.69***
		(7.632)	(1.480)	(7.264)	(7.045)
Control variables included		Yes	Yes	Yes	Yes
Observations		31,722	25,865	25,540	21,589
Adjusted R-squared		0.110	0.108	0.110	0.129

Note: The dependent variable is subjective well-being as GHQ-12. Robust standard errors are given in parentheses. Other coefficients and control variables can be found in Appendix G. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 7. Effects of the interaction term and its main effects in the period 2010-2019

Variable	Model 9	Model 10	Model 11	Model 12
Rural*1st Quintile	No significant difference	No significant difference	0.179 (0.589 – 0.410)	No significant difference
Rural *2nd Quintile	No significant difference	No significant difference	0.161 (0.812 – 0.241 – 0.410)	No significant difference
Rural *4th Quintile	No significant difference	0.238 (-0.461 + 0.254 + 0.445)	0.562 (0.972 – 0.410)	0.464
Rural *5th Quintile	No significant difference	No significant difference	0.525 (0.935 – 0.410)	0.675

6 DISCUSSION

This study aimed to build on the efforts of earlier research on happiness by providing an overarching framework, including variables from various domains within the Science of Happiness, to create a wider understanding of happiness. The main focus was placed on the effects of relative income on the happiness of urban and rural populations in England. This chapter discusses the main findings, their implications, and how the findings fit into the current body of literature.

6.1 Relative income and urban-rural differentials

The results and analysis from the OLS model have shown that there is a significant difference in the effect of relative income on the happiness of urban and rural populations in England. More specifically, this difference is found between urban middle-income populations and rural high(er)-income populations. Rural individuals in the fourth and fifth income quintile report significantly higher scores on their subjective well-being, of respectively 0.464 and 0.675, compared to urban middle-income individuals. However, such differences are not observed comparing urban middle-income populations and rural middle- and low-income populations.

The significance of the interaction terms, compared to relative income variable, is in line with the findings of Boyce et al. (2010) that rank income dominates over relative income when explaining variation in happiness. Although the study of Rijnks et al. (2019) focused on affluent and less affluent areas, rather than urban-rural differentials, it is interesting to see that they have not found significant results for the impact of relative income on the happiness of low-income households either. Rijnks et al. (2019) argue that might be the result of less need to adjust utility and consumption to comparable levels of others around them in specific areas, which has the potential to cause inefficiency (Winkelmann, 2012). This might suggest that above-average income individuals are more affected by social comparison than below-average income individuals, may it be negative or positive. Furthermore, the

finding that someone with a high income would be happier living in a rural area than someone with a middle-income in an urban area might suggest that wealth can bridge differences between urban and rural areas. For example, the increased distance from rural areas to amenities and services in urban areas can be large, but this might not be detrimental for happiness if the individual can make use of luxurious transport modes. Moreover, with the use of luxurious transport modes, the individual can enjoy both the benefits of rural living and urban services without too many compromises. Contrary, middle-income individuals may have to make compromises between rural living and urban services. Furthermore, one could argue that rural high-income individuals are able to travel more often through urban middle-income neighbourhoods. This enables more possibilities to reflect on their personal situation, feeling better or happier about rural high-income living. However, this would need further research to make profound statements.

Furthermore, the differences in the effect of relative income on urban and rural populations can come from proximity to a reference group as well as the strength of bonds to the reference group. Rijnks et al. (2019) and Knight & Gunatilaka (2010) argued for the importance of a reference group nearby. However, this effect can be disturbed by the low population density of rural areas in England. On the other hand, strong ties to family and friends can contribute to the reference group. Yet, there are heterogeneous views on whether this effect of social capital is stronger in urban or rural areas (see Helliwell et al., 2020; Sørensen, 2016; Dijkstra & Papadimitriou, 2020). The results are not able to provide perspective on which of these factors had the upper hand in the effect of social comparison and relative income, although social capital has been controlled for in the model.

6.2 Objective and subjective happiness

To differentiate between objective and subjective measures within the Science of Happiness, further analysis has provided findings on the differences between *quality of life* and *happiness.* The outcomes show that, as expected based on the literature, the effects of drivers in the model have different impacts between the two dependent variables. Especially the variables *Multiple Deprivation Index* and *distance to national park* stand out in the final model. These variables were not found to be significant explanatory variables for *subjective well-being,* while this was the case for *life satisfaction.*

Many of the underlying domains of MDI are captured in the social and physical dimensions of *quality of life* (see Rogerson et al., 1989; Ballas, 2013), such as crime, education, health, and housing. Furthermore, distance to a national park contributes to the physical environmental dimension of quality of life (Rogerson et al., 1989). This can explain why these variables had a significant contribution to one's reported life satisfaction, while not to one's happiness.

Surprisingly, the effect of social capital was insignificant for both models. Whereas Neira et al. (2018) and Puntscher et al. (2015) found social capital to be a significant contributor to individuals' happiness, this study does not confirm this argument. However, the finding that social capital has no significant effect on life satisfaction does correspond to earlier findings by Puntscher et al. (2015). The

studies by Neira et al. (2018) and Puntscher et al. (2015) were performed on a similar spatial scale as this study. However, this study focuses on only a small set of regions since it is limited to England. Neira et al. (2018) and Puntscher et al. (2015) applied a broader perspective by the inclusion of many European regions. The application of a lower spatial scale or a larger set of regions potentially can influence the outcomes of the relationship between happiness and relative income due to the inclusion of more (detailed) data.

The subjective and relative nature of the interaction between the urban-rural indicator and the income quintiles may have led to more significant results for the OLS model compared to the ordered logistic model. The contribution of the interaction term between the income quintiles and the urban-rural dummy was found significant for both the fourth and fifth income groups in the subjective well-being model, whereas this was only the case for the highest income group in the life satisfaction model. This finding might suggest that life satisfaction is still subject to the consequences of social comparison, although to a significantly lesser extent than subjective well-being.

Lastly, the findings show that the distance to a national park has a significant negative effect on reported life satisfaction, which suggests that a larger distance to a national park causes life satisfaction to decrease. This confirms the finding by Brereton et al. (2008) that environmental characteristics and the distance to these characteristics can contribute to the explanation of life satisfaction. Moreover, given the current circumstances relating to the Corona crisis, the relevance of shorter distances to, for example, national parks might have increased in 2020 and 2021. The need for people to spend more time at home, regions, and countries being in lockdown, and having installed travel restrictions might have led to increased appreciation of nature and national parks within the proximity. Future research possibly can provide evidence whether this was the case and to what extent.

6.3 Relationship between relative income and happiness over time

The analysis of the relationship between income and happiness in England over time confirms the presence of the Easterlin Paradox. Over the period 2010-2019 average income in England has increased, while reported happiness remained relatively stable until the small downswing in 2019 (see figure 8). This suggests that there is no direct relationship between happiness and absolute income, which corresponds to previous findings on the Easterlin Paradox (see Easterlin & O'Connor, 2020; Easterlin, 1974; Ma et al., 2018). To study the relevance of relative income on urban and rural populations over time, four regressions have been performed using data from four different waves between 2010 and 2019.

Earlier it was discussed that income can increase your happiness if this means that your relative position improves. The relatively high income inequality in England (ONS, 2021; OECD, 2021) could be a motive to observe significant results between income groups. Over the period 2010-2019, income inequality decreased slightly (see figure 2), which led to the expectation that the relevance of relative income would have decreased as well. Yet, the results of the regressions have shown that the relevance

of relative income is rather inconclusive. Comparing the results of the four waves, there is no driver of happiness which has had a significant impact over all of the years. For rural low-income groups, most results show that there no significant difference compared to urban middle-income groups. Only in the year 2016 there was found a significant difference between these groups. Furthermore, the coefficients observed for the interaction term and its main effects of rural high-income groups compared to urban middle-incomes in table 7 fluctuated. Based on the models, no conclusions can be drawn as to what causes this observation. However, this finding might suggest that the preferences of urban and rural populations might shift over time, for both relative income and other objective drivers.

6.4 Limitations and recommendations

This study suffered from limitations relating to the data and, consequently, the analysis. The main limitation was the spatial level at which the data is provided, which is an often occurring case when using spatial variables (Brereton et al., 2008). The Understanding Society data set provides two spatial variables: (1) the governmental regions, and (2) the urban-rural indicator. The governmental regions are a NUTS-1 subdivision of England, with the result that the regions each cover a relatively large area of England. Data on, for example, neighbourhoods level or ZIP-codes would enable more detailed analysis. Furthermore, the data included a variable to differentiate between urban and rural areas. However, previous literature has argued for the inclusion of an urban-rural continuum, differentiating between cities, towns and semi-dense areas, and rural areas (Dijkstra & Papadimitriou, 2020). As a result of these limitations, the study is not able to provide profound analysis of relative income and happiness on disaggregated spatial levels.

7 CONCLUSION

This study has aimed to answer the following research questions: "*To what extent is there a difference in the way relative income influences happiness of the urban and rural populations in England?*". By employing quantitative analysis techniques, this study provided an overarching view on the relationship between happiness, relative income, and other domains within the Science of Happiness.

The results of this study have shown that, in 2019, rural individuals in the fourth and fifth income quintile reported significantly higher scores on their happiness compared to urban middle-income individuals, of respectively 0.464 and 0.675. Contrary, rural middle- and low-income individuals were not found to report significantly different happiness levels than urban middle-income individuals. A similar phenomenon was observed for life satisfaction, where rural individuals within the highest income group reported significantly higher scores than urban middle-income individuals. However, the effects of relative income on happiness were inconclusive when analysing four waves during the period 2010-2019.

To conclude this study, the extent to which there is a difference in the way relative income influences happiness of the urban and rural populations in England depends on the income groups and year considered. This study has shown that in 2019, rural high-income individuals reported significantly higher scores for their happiness than urban middle-income individuals. However, no significant differences have been found between rural middle- and low-income individuals on one hand, and urban middle-income individuals on the other hand. Furthermore, the extent to which relative income influences happiness over the years was found to vary.

Although relative income has been studied in a variety of contexts, this study contributes to the current body of literature by providing a perspective in which urban-rural differentials are explained. This embodies the need for wider incorporation of geographical context into the Science of Happiness. It has shown that there are significant differences in the way relative income impacts the reported happiness of urban and rural individuals, although limited to a specific set of income groups. Meanwhile, this study accounts for other domains within the Science of Happiness as well, providing an overarching view on happiness.

For future research, it is interesting to study how the Corona crisis has impacted the influence of certain drivers on happiness. The lockdown caused isolation for many people, from family, friends, and amenities. Firstly, the importance of social capital might have changed as people relied more on interpersonal relationships to prevent them from experiencing isolation. As a result, the importance of social capital might have increased during 2020 and 2021. Due to the larger distances between households in rural areas, rural households might have suffered more from social isolation than urban households. Moreover, urban households may have a larger social structure of support in the case of, for example, quarantine. Secondly, the lockdown and travel restrictions may have changed individuals' appreciation to live close to a park or a city. The ability to spend time outdoors might have become more valuable to one's happiness. However, the characteristics of rural living may have lowered the need for rural households to have access to natural parks compared to urban households. Furthermore, for low-income households without private transport the distance to nature might have been hard to cover due to lower supply of public transport. Contrary, high-income households possibly did not face any difficulties concerning transportation as a result of more resources to afford private transportation. As a result, the impact of distance to nature might be found to be more valuable to reported happiness of urban households than rural households. Future research may be able to provide profound evidence on these issues.

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9 DATA SOURCES

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10 APPENDICES

10.1 Appendix A: Data management and cleaning

Variable	Syntax (Stata)	Rationale	Number of observations dropped
Age	drop if j_dvage < 16	Only respondents aged 16 or above can participate	12
Life satisfaction	drop if j_sclfsato < 1	Scores below 1 indicate missing values	2,202
Longstanding illness	drop if j_health < 1	Scores below 1 indicate missing values	62
Marital status	drop if j_marstat < 1	Scores below 1 indicate missing values	174
Urban-rural	drop if j_urban_dv < 1	Scores below 1 indicate missing values	20
Income	drop if j_fihhmnnet1_dv < 1	No negative value for income possible	115
Employment	drop if j_jbstat < 1	Scores below 1 indicate missing values	11
Education	drop if j_qfhigh_dv < 1	Scores below 1 indicate missing values	4,260
Number of kids	drop if j_nkids_dv >6	Scores below 1 indicate missing values	585
Governmental regions	drop if j_gor_dv==10 drop if j_gor_dv==11 drop if j_gor_dv==12	Scotland, Ireland and Wales are excluded from the analysis	4,778
Subjective well-being GHQ-12	drop if j_scghq1_dv < 0	Scores below 1 indicate missing values	217
Total			12,436

10.2 Appendix B: Complementary data

Variable	Description	Reference
Relative income	Use the average regional gross household income after tax deductions to calculate the respondent's deviation from the regional average.	2010: Office for National Statistics (n.d.). 2013: Office for National Statistics (2015). 2016: Office for National Statistics (2018). 2019: Office for National Statistics (2020).
Multiple Deprivation Index	Use the English indices of deprivation to award each region an average score of all neighbourhoods in the region.	2015: GOV.UK (2015). 2019: GOV.UK (2019).

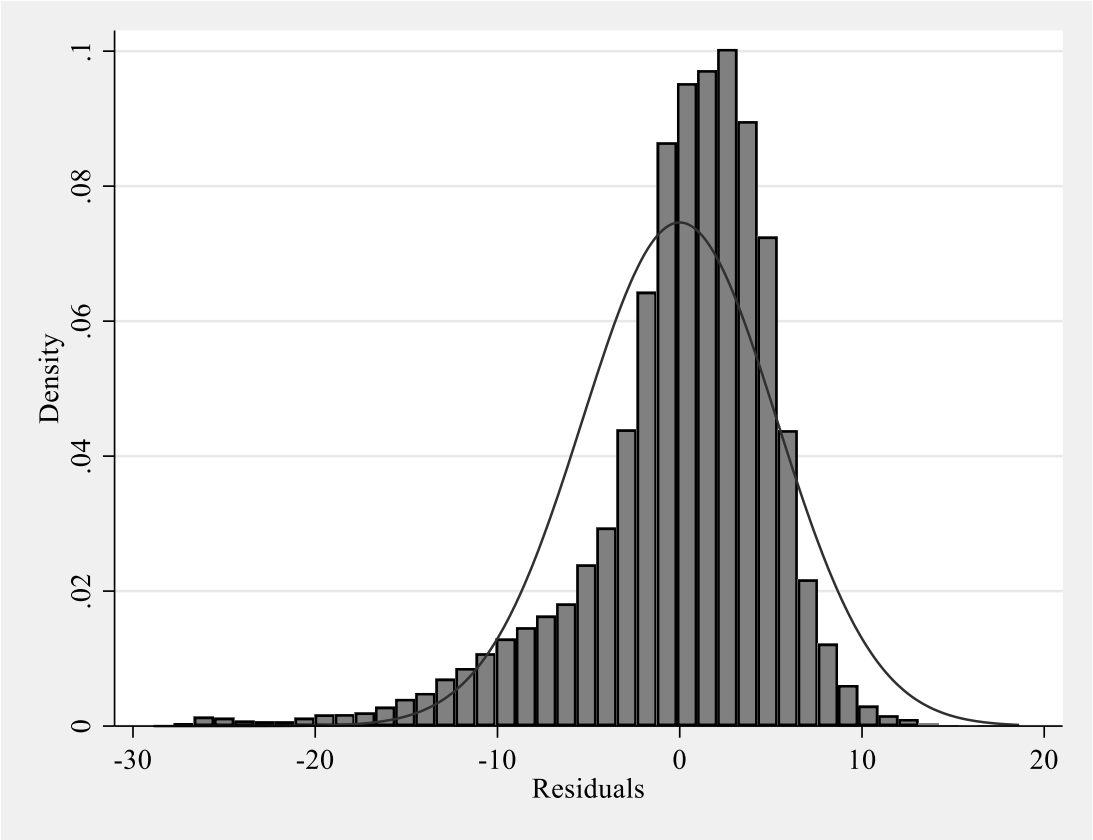
10.3 Appendix C: Full estimation results model 1-4 Subjective well-being GHQ

Variable	Category	Model 1	Model 2	Model 3	Model 4
Log relative income		0.297**	0.187	-0.430	0.109
		(0.119)	(0.222)	(0.369)	(0.773)
Urban rural (ref = urban)		0.186	-0.262	-0.215	-0.219
		(0.207)	(0.196)	(0.197)	(0.197)
Quintile (ref=3)	1st Q	-0.385**	-0.0293	-0.0309	-0.0358
		(0.186)	(0.183)	(0.183)	(0.184)
	2nd Q	-0.169	-0.123	-0.128	-0.129
		(0.144)	(0.136)	(0.136)	(0.136)
	4th Q	0.0196	-0.121	-0.121	-0.119
		(0.138)	(0.133)	(0.133)	(0.133)
	5th Q	-0.0355	-0.259	-0.266*	-0.260
		(0.159)	(0.161)	(0.161)	(0.161)
Rural*Quintile (ref=urban+Q3)	R*1st Q	0.292	0.0716	0.0757	0.0702
		(0.323)	(0.298)	(0.299)	(0.299)
	R*2nd Q	0.469	0.366	0.372	0.369
		(0.292)	(0.271)	(0.272)	(0.272)
	R*4th Q	0.307	0.462*	0.462*	0.464*
		(0.282)	(0.270)	(0.270)	(0.270)
	R*5th Q	0.517*	0.667**	0.677**	0.675**
		(0.281)	(0.267)	(0.268)	(0.268)
Log household income			-0.0506	0.565	0.0227
			(0.246)	(0.383)	(0.784)
Age	Age		-0.00840	-0.00919	-0.00952
			(0.0143)	(0.0143)	(0.0143)
	Age squared		0.000461***	0.000470***	0.000473***
			(0.000139)	(0.000139)	(0.000139)
Longstanding illness (ref=no)			-2.317***	-2.314***	-2.317***
			(0.0853)	(0.0853)	(0.0854)
Sex (ref=male)			-1.029***	-1.029***	-1.029***
			(0.0749)	(0.0749)	(0.0748)
Marital status (ref=single)	Married		0.379***	0.382***	0.383***
			(0.119)	(0.119)	(0.119)
	Divorced		0.0245	0.0319	0.0346
			(0.162)	(0.162)	(0.162)
	Widowed		-0.165	-0.164	-0.161
			(0.205)	(0.205)	(0.205)
Employment (ref=unemployed)	Self-employed		2.965***	2.977***	2.975***
			(0.284)	(0.284)	(0.284)
	Employee		2.776***	2.787***	2.788***
			(0.260)	(0.260)	(0.260)
	Retired		2.936***	2.945***	2.942***
			(0.286)	(0.286)	(0.285)
	Family & home		2.334***	2.348***	2.348***
			(0.325)	(0.325)	(0.325)
	Illness & disability		-3.184***	-3.183***	-3.186***
			(0.408)	(0.408)	(0.408)
	Other		2.610***	2.605***	2.607***
			(0.311)	(0.311)	(0.311)

Education (ref=level 1)	Level 2		-0.230*	-0.237*	-0.234*
			(0.135)	(0.135)	(0.135)
	Level 3		-0.263	-0.268*	-0.265
			(0.161)	(0.161)	(0.161)
	Level 4		-0.166*	-0.176*	-0.176*
			(0.0976)	(0.0977)	(0.0977)
	Other		0.120	0.118	0.120
			(0.112)	(0.112)	(0.112)
Number of kids			-0.0980**	-0.101**	-0.0994**
			(0.0498)	(0.0498)	(0.0498)
Tenure (ref=owned no mortg)	Owned mortgage		-0.368***	-0.364***	-0.369***
			(0.0989)	(0.0989)	(0.0989)
	Public housing		-0.937***	-0.957***	-0.960***
			(0.139)	(0.139)	(0.139)
	Private rent		-0.674***	-0.680***	-0.689***
			(0.148)	(0.148)	(0.148)
Social capital index				0.0123	-0.0166
				(0.0138)	(0.0202)
Multiple Deprivation Index				0.0334**	0.0174
				(0.0138)	(0.0203)
Distance to London					-0.000167
					(0.00132)
Distance to national park					-0.00531
					(0.00372)
Constant		25.35***	24.20***	18.09***	24.69***
		(0.120)	(1.905)	(3.742)	(7.045)
Observations		21,589	21,589	21,589	21,589
R-squared		0.005	0.130	0.130	0.130
Adjusted R-squared		0.00466	0.128	0.129	0.129
p-value		0.0000	0.0000	0.0000	0.0000
RSS		705641	617020	616828	616720
MSS		3630	92252	92443	92551
Root MSE		5.719	5.350	5.350	5.349
F-statistic		10.86	75.88	71.52	67.70
Degrees of freedom		10	32	34	36

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

10.4 Appendix D: Test for normally distributed errors



	Percentiles	Smallest		
1%	-18.34156	-28.86497		
5%	-10.55949	-28.04885		
10%	-7.04214	-27.86271	Obs	21,589
25%	-2.02592	-27.81262	Sum of Wgt.	21,589
50%	.9221559		Mean	-1.14e-09
		Largest	Std. Dev.	5.346204
75%	3.444717	14.72805		
90%	5.359038	17.0486	Variance	28.58189
95%	6.511145	17.67446	Skewness	-1.395226
99%	9.215751	18.62252	Kurtosis	6.279587

10.5 Appendix E: Variance Inflation Factor (VIF)

Variable	VIF	1/VIF (Tolerance)
Ln relative income	216.98	0.004704
Urban - rural	1.10	0.91095
Income quintile	4.57	0.21825
Ln household income	212.58	0.004609
Age	2.21	0.453047
Longstanding illness	1.16	0.865747
Sex	1.03	0.975431
Marital status	1.61	0.622482
Employment	1.08	0.921744
Education	1.07	0.933508
Number of kids	1.18	0.849100
Tenure	1.29	0.776615
Social capital	4.48	0.223284
Multiple Deprivation Index	6.25	0.159926
Distance to London	20.93	0.047784
Distance to national park	4.78	0.209073
Mean VIF	30.14	

10.6 Appendix F: Full estimation results model 5-8 Life satisfaction

Variables	Categories	Model 5	Model 6	Model 7	Model 8
Log relative income		0.145***	0.298***	0.273**	0.502*
		(0.0369)	(0.0733)	(0.124)	(0.267)
Urban rural (ref = urban)		0.126*	-0.0206	-0.0340	-0.0366
		(0.0676)	(0.0686)	(0.0689)	(0.0689)
Quintile (ref=3)	1st Q	-0.0958*	-0.0891	-0.0888	-0.0901
		(0.0570)	(0.0626)	(0.0626)	(0.0626)
	2nd Q	-0.0314	-0.0535	-0.0519	-0.0515
		(0.0454)	(0.0467)	(0.0467)	(0.0467)
	4th Q	0.0650	0.0530	0.0534	0.0540
		(0.0450)	(0.0462)	(0.0462)	(0.0462)
	5th Q	0.114**	0.116**	0.122**	0.125**
		(0.0515)	(0.0562)	(0.0562)	(0.0562)
Rural*Quintile (ref=urban+Q3)	R*1st Q	0.151	0.0787	0.0794	0.0767
		(0.102)	(0.103)	(0.103)	(0.103)
	R*2nd Q	0.151	0.144	0.143	0.142
		(0.0983)	(0.0989)	(0.0989)	(0.0989)
	R*4th Q	0.0715	0.128	0.125	0.126
		(0.0949)	(0.0960)	(0.0960)	(0.0960)
	R*5th Q	0.157*	0.208**	0.195**	0.194**
		(0.0949)	(0.0961)	(0.0962)	(0.0962)
Log household income			-0.268***	-0.243*	-0.473*
			(0.0834)	(0.130)	(0.270)
Age	Age		-0.0420***	-0.0415***	-0.0416***
			(0.00493)	(0.00494)	(0.00494)
	Age squared		0.000451***	0.000445***	0.000446***
			(5.09e-05)	(5.10e-05)	(5.10e-05)
Longstanding illness (ref=no)			-0.773***	-0.775***	-0.776***
			(0.0289)	(0.0289)	(0.0289)
Sex (ref=male)			0.0127	0.0131	0.0133
			(0.0259)	(0.0259)	(0.0259)
Marital status (ref=single)	Married		0.374***	0.370***	0.370***
			(0.0388)	(0.0388)	(0.0388)
	Divorced		0.0713	0.0654	0.0669
			(0.0517)	(0.0517)	(0.0517)
	Widowed		0.0160	0.0125	0.0139
			(0.0723)	(0.0723)	(0.0723)
Employment (ref=unemployed)	Self-employed		0.723***	0.717***	0.717***
			(0.0805)	(0.0805)	(0.0806)
	Employee		0.643***	0.637***	0.638***
			(0.0693)	(0.0693)	(0.0693)
	Retired		1.209***	1.205***	1.204***
			(0.0835)	(0.0836)	(0.0836)
	Family & home		0.660***	0.655***	0.654***
			(0.0907)	(0.0907)	(0.0907)
	Illness & disability		-0.690***	-0.697***	-0.699***
			(0.100)	(0.100)	(0.100)
	Other		0.874***	0.877***	0.879***

			(0.0877)	(0.0877)	(0.0877)
Education (ref=level 1)	Level 2		-0.0793*	-0.0770*	-0.0757*
			(0.0449)	(0.0449)	(0.0449)
	Level 3		0.0376	0.0371	0.0396
			(0.0526)	(0.0527)	(0.0527)
	Level 4		0.0762**	0.0797**	0.0799**
			(0.0337)	(0.0337)	(0.0337)
	Other		0.0316	0.0335	0.0347
			(0.0386)	(0.0386)	(0.0386)
Number of kids			-0.0462***	-0.0453***	-0.0440***
			(0.0156)	(0.0156)	(0.0156)
Tenure (ref=owned no mortg)	Owned mortgage		-0.0984***	-0.0994***	-0.103***
			(0.0350)	(0.0350)	(0.0350)
	Public housing		-0.407***	-0.397***	-0.399***
			(0.0447)	(0.0448)	(0.0448)
	Private rent		-0.262***	-0.259***	-0.264***
			(0.0480)	(0.0480)	(0.0480)
Social capital index				0.00924**	-0.00567
				(0.00471)	(0.00701)
Multiple Deprivation Index				-0.00293	-0.0124*
				(0.00470)	(0.00709)
Distance to London					2.60e-05
					(0.000464)
Distance to national park					-0.00255*
					(0.001307)
Cut 1		-3.739***	-6.259***	-5.552***	-8.557***
		(0.0597)	(0.643)	(1.277)	(2.427)
Cut 2		-2.578***	-5.040***	-4.333***	-7.338***
		(0.0453)	(0.642)	(1.276)	(2.427)
Cut 3		-1.581***	-3.971***	-3.264**	-6.268***
		(0.0403)	(0.641)	(1.276)	(2.427)
Cut 4		-0.850***	-3.176***	-2.469*	-5.473**
		(0.0388)	(0.641)	(1.276)	(2.426)
Cut 5		-0.0144	-2.261***	-1.554	-4.557*
		(0.0384)	(0.641)	(1.276)	(2.426)
Cut 6		2.319***	0.222	0.930	-2.073
		(0.0427)	(0.641)	(1.276)	(2.426)
Observations		21,584	21,584	21,584	21,584
p-value		0.0000	0.0000	0.0000	0.0000
Chi-square		245.3	2904	2913	2922
Log likelihood		-34273	-32944	-32939	-32935
Pseudo R-squared		0.00357	0.0422	0.0423	0.0425

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

10.7 Appendix G: OLS model – wave A, D, G, J

Variable	Category	Model 9-A	Model 10-D	Model 11-G	Model 12-J
Log relative income		2.497***	-0.0136	-1.262	0.109
		(0.912)	(0.0568)	(0.805)	(0.773)
Urban rural (ref = urban)		0.00327	0.445**	-0.410**	-0.219
		(0.161)	(0.181)	(0.192)	(0.197)
Quintile (ref=3)	1st Q	-0.231	0.0356	-0.160	-0.0358
		(0.150)	(0.183)	(0.176)	(0.184)
	2nd Q	-0.202*	0.0248	-0.241*	-0.129
		(0.112)	(0.132)	(0.127)	(0.136)
	4th Q	0.0841	0.254**	-0.154	-0.119
		(0.103)	(0.128)	(0.124)	(0.133)
	5th Q	0.150	0.179	-0.155	-0.260
		(0.125)	(0.162)	(0.157)	(0.161)
Rural*Quintile (ref=urban+Q3)	R*1st Q	0.190	-0.414	0.589**	0.0702
		(0.243)	(0.278)	(0.279)	(0.299)
	R*2nd Q	0.149	-0.252	0.812***	0.369
		(0.231)	(0.253)	(0.272)	(0.272)
	R*4th Q	0.0881	-0.461*	0.972***	0.464*
		(0.217)	(0.247)	(0.253)	(0.270)
	R*5th Q	0.232	-0.367	0.935***	0.675**
		(0.205)	(0.242)	(0.250)	(0.268)
Log household income		-2.406***	0.364**	1.451*	0.0227
		(0.918)	(0.144)	(0.814)	(0.784)
Age	Age	-0.111***	-0.0593***	-0.0337**	-0.00952
		(0.0121)	(0.0140)	(0.0133)	(0.0143)
	Age squared	0.00119***	0.000845***	0.000544***	0.000473***
		(0.000127)	(0.000138)	(0.000132)	(0.000139)
Longstanding illness (ref=no)		-2.038***	-1.974***	-2.301***	-2.317***
		(0.0685)	(0.0811)	(0.0821)	(0.0854)
Sex (ref=male)		-0.761***	-1.050***	-0.990***	-1.029***
		(0.0605)	(0.0709)	(0.0691)	(0.0748)
Marital status (ref=single)	Married	0.494***	0.131	0.328***	0.383***
		(0.0931)	(0.111)	(0.107)	(0.119)
	Divorced	-0.134	-0.372**	-0.246	0.0346
		(0.130)	(0.148)	(0.150)	(0.162)
	Widowed	-0.285	-0.120	0.238	-0.161
		(0.175)	(0.184)	(0.182)	(0.205)
Employment (ref=unemployed)	Self-employed	1.860***	2.437***	2.548***	2.975***
		(0.183)	(0.238)	(0.249)	(0.284)
	Employee	1.951***	2.247***	2.472***	2.788***
		(0.158)	(0.208)	(0.227)	(0.260)
	Retired	2.054***	2.358***	2.696***	2.942***
		(0.190)	(0.239)	(0.254)	(0.285)
	Family & home	1.273***	1.546***	1.825***	2.348***
		(0.190)	(0.253)	(0.275)	(0.325)
	Illness & disability	-3.150***	-3.845***	-3.170***	-3.186***
		(0.294)	(0.355)	(0.379)	(0.408)
	Other	1.984***	1.706***	2.295***	2.607***
		(0.195)	(0.258)	(0.265)	(0.311)

Education (ref=level 1)	Level 2	-0.300***	-0.311**	-0.115	-0.234*
		(0.106)	(0.128)	(0.123)	(0.135)
	Level 3	-0.0812	-0.124	0.0140	-0.265
		(0.123)	(0.149)	(0.143)	(0.161)
	Level 4	0.0838	-0.0973	-0.0495	-0.176*
		(0.0788)	(0.0926)	(0.0898)	(0.0977)
	Other	0.00484	-0.0165	0.147	0.120
		(0.0908)	(0.102)	(0.101)	(0.112)
Number of kids		-0.0699*	-0.0122	-0.0245	-0.0994**
		(0.0359)	(0.0429)	(0.0424)	(0.0498)
Tenure (ref=owned no mortg)	Owned mortgage	-0.756***	-0.528***	-0.399***	-0.369***
		(0.0837)	(0.0951)	(0.0934)	(0.0989)
	Public housing	-0.884***	-0.779***	-0.878***	-0.960***
		(0.111)	(0.127)	(0.126)	(0.139)
	Private rent	-0.746***	-0.740***	-0.567***	-0.689***
		(0.108)	(0.135)	(0.129)	(0.148)
Social capital index		-0.0250*	0.00485	-0.0122	-0.0166
		(0.0139)	(0.0116)	(0.0200)	(0.0202)
Multiple Deprivation Index		-0.00597	-0.0123*	-0.0136	0.0174
		(0.00565)	(0.00628)	(0.0190)	(0.0203)
Distance to London		-0.00249***	0.000589	0.00158	-0.000167
		(0.000924)	(0.000629)	(0.00135)	(0.00132)
Distance to national park		-0.0156***	-0.00353*	-0.00126	-0.00531
		(0.00320)	(0.00213)	(0.00381)	(0.00372)
Constant		48.43***	23.56***	15.58**	24.69***
		(7.632)	(1.480)	(7.264)	(7.045)
Observations		31,722	25,865	25,540	21,589
R-squared		0.111	0.109	0.112	0.130
Adjusted R-squared		0.110	0.108	0.110	0.129
p-value		0.0000	0.0000	0.0000	0.0000
RSS		842452	773364	730316	617026
MSS		105644	94791	92317	92245
Root MSE		5.156	5.472	5.351	5.351
F-statistic		74.92	63.27	63.19	68.90
Degrees of freedom		36	36	36	36

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1