

Volland, Benjamin

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## Conscientious consumers? Preferences, personality and expenditure in the UK

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# PAPERS on Economics & Evolution



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# 1305

**Conscientious consumers?  
Preferences, personality and expenditure in the UK**

by

**Benjamin Volland**

The *Papers on Economics and Evolution* are edited by the Evolutionary Economics Group, MPI Jena. For editorial correspondence, please contact: [evopapers@econ.mpg.de](mailto:evopapers@econ.mpg.de)

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Max Planck Institute of Economics  
Evolutionary Economics Group  
Kahlaische Str. 10  
07745 Jena, Germany  
Fax: ++49-3641-686868

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## Conscientious consumers? Preferences, personality and expenditure in the UK

Benjamin Volland

Max Planck Institute of Economics<sup>φ</sup>

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### Abstract

While the importance of personality for understanding differences in labor market outcomes has come to be increasingly appreciated by economic scholars, little research has so far focused on the question whether these measures also explain some of the individual heterogeneity in demand behavior. Using data from the British Household Panel Survey, this study provides evidence for the relationship between the Big Five personality traits and expenditures for food away from home and other leisure activities. Additionally, we assess the relationship between dimensions of personality and individual preferences in predicting expenditure on these categories. Results indicate that aspects of personality predict a non-negligible part of expenditure behavior, and that these effects are independent of the individual's preference stock. Our results provide empirical support for approaches that include personality as a constraint into economic models of human behavior.

JEL Classification: D12

Keywords: Personality; Five Factor Model; Expenditures; Leisure; UK

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<sup>φ</sup> Corresponding author: Benjamin Volland, Max Planck Institute of Economics, Evolutionary Economics Group, Kahlaische Strasse 10, 07745 Jena, [volland@econ.mpg.de](mailto:volland@econ.mpg.de)

## 1. Introduction

Recent years have seen increased efforts by economists to integrate psychological concepts and measures of personality into economic models of decision making and to empirically assess the impact of personality on a wide range of behaviors (Caplan 2003; Borghans et al. 2008a; Almlund et al. 2011; Becker et al. 2012). Dimensions of personality have, for example, been shown to explain some of the variation in wages, earnings, and employment status (e.g., Mueller and Plug 2006; Heineck 2011; Fletcher 2013), occupational choice and educational attainment (e.g., Heckman et al. 2006), or entrepreneurial intentions and success (Zhao and Seibert 2006; Zhao et al. 2010; Cantner et al. 2012).

However, unlike research in marketing and personality psychology, little research in economics has focused on the effects of personality dimensions on demand behavior. One of the reasons for the apparent lack of interest in the relationship between personality and expenditures within the discipline can be found in the lack of appropriate survey data. Indeed measures of personality are absent from most commonly used expenditure surveys, and have only recently been included in the more general purpose surveys like the German Socio-Economic Panel (GSOEP) or the British Household Panel Survey (BHPS). Moreover, the impressive progress made in personality psychology over the past three decades has only gradually come to the attention of economic researchers in the field of demand analysis.

Yet, there is good reason to believe that there is a non-trivial relationship between an individual's personality and her expenditure behavior. Personality psychology and management literature, for instance, argue that differences in personality should directly and indirectly affect consumer behavior (e.g., Baumgartner 2002; Bosnjak et al. 2007). For one, personality traits can be understood as a part of the individual's set of situationally and temporally (largely) invariant dispositions which, like preferences, could guide behavior directly and therefore lead to consistencies in behavioral patterns (Baumgartner 2002). Second, personality may also influence consumption behavior more indirectly by affecting educational attainment and occupational choice (Heckman et al. 2006; Jackson 2006), and thereby determine the income available for consumption (Mueller and Plug 2006; Heineck 2011; Fletcher 2013). Moreover, personality traits have been found to be related to an individual's willingness to take risks (Zuckerman and Michael 2000), which in turn may affect an individual's consumption habits, for instance by increasing the likelihood of consumption of addictive goods. Finally, it has been suggested that personality profiles may be utilized to overcome one of the most deep-rooted problems in empirical demand analysis, namely the common (but usually not explicitly expressed) assumption that preferences are identical across individuals, such that heterogeneity in demand behavior can be satisfactorily explained by heterogeneity in the budget constraint alone (cf. Caplan 2003).<sup>1</sup> Most prominently, Caplan (2003) argues that measures of personality may provide a direct empirical operationalization of individual preference structures, thus offering a straightforward possibility to control for heterogeneity in preferences. His argument is based on the observation that personality dimensions show two characteristics that are commonly

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<sup>1</sup> For more extensive critiques of this treatment of preferences in economic thought and its consequences for the explanatory power of economic approaches to human behavior see, among others Ironmonger (1972) and Witt (2001).

considered as defining for economic preferences. First, that they explain a substantial share of the heterogeneity in behavior across individuals. Second, that they exhibit comparatively little within variation, i.e. that they are highly – but not perfectly – stable over time. Similarly, Almlund et al. (2011) model personality as an agent’s endowments ultimately made up of her information set, capabilities, and preferences, also suggesting a close relationship between an individual’s preference sets and personality. However, so far little empirical research has been devoted to understanding the relationship between these concepts.<sup>2</sup>

In this paper, we draw on the so-called Five Factor Model to measure personality (Digman 1990; McCrae and John 1992). We then analyze the relationship between these personality measures and expenditures for food away from home and other leisure activities in the United Kingdom. In particular, we are interested in the concrete channel by which personality is likely to influence expenditure on these categories. We therefore investigate whether (a) dimensions of personality are *ceteris paribus* associated with expenditure patterns, (b) these associations can be understood as a direct effect of personality on demand, independent of the individual’s set of preferences over these goods, and (c) whether there is evidence for additional indirect effects of personality on expenditures mediated through education, income and health. Since measures of preferences are not commonly available in expenditure data sets, we draw on the literature on intergenerational transmission in preferences (Waldkirch et al. 2004; Volland 2013) in order to construct them.

While the choice of expenditure categories used in this study is to some extent dictated by data availability, analyzing the distribution of income in general and over leisure expenditures in particular is not without interest itself. For one, due to declining market work time, income growth and consumer specialization patterns, expenditures on leisure and recreational activities (including the consumption of food at restaurants and hotels) have increased overproportionally over the past 50 years (Nelson 2001; Chai 2011) and now represent a substantial share of total consumer spending in the UK. According to data from the Office for National Statistics, roughly 25% of the average weekly household expenditure in Britain was devoted to these activities in 2010. In comparison, expenditures on health and educational attainment measured in the same year only contributed 1.2% and 2.5%, respectively (ONS 2011). Hence, analyzing expenditures over these goods provides increasingly important insights on the factors explaining heterogeneity in total consumer spendings and quality of living. Moreover, understanding aspects that lead to inter-individual differences in leisure expenditure behavior may also inform policy makers, as the way in which individuals spent their leisure time has substantial implications for individual and social welfare. Crompton (2008), for instance, surveys the empirical evidence highlighting the contributions of leisure activities to alleviating a number of social problems like facilitating healthy lifestyles, improving cultural and historical preservation, or reducing environmental stress. On top of that, it is apparent that the way in which individuals distribute their income is likely to affect their health and human capital development (Mancini et al. 2011), thus also contributing indirectly to their earnings potential. Take, for example, the different human capital (and health) effects of expenditures on further education classes as compared to expenditures on

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<sup>2</sup> A notable exception is the paper by Becker et al. (2012).

regular outings to the local pub. Finally, using expenditures over food consumed outside the household and other leisure activities provides a potentially fertile ground for analyzing the relationship between personality and preferences. It is, for instance, intuitively appealing to argue that an individual's preferences over leisure activities may be shaped to a substantial extent by her tendency to seek and enjoy new experiences, i.e. by a personality trait commonly known as openness-to-experience in psychology (Caspi et al. 2005). Or that her preferences over dining out (i.e. food consumed away from home) are closely related to how outgoing and sociable she is. In short, to personality traits labeled "extraversion" and "agreeableness" by personality researchers (Caspi et al. 2005). Yet, it remains to be demonstrated whether this intuitive association between personality and preferences is reflected in real-world data.

In what follows, we first introduce measures of personality as developed in psychology (Section 2), before briefly discussing the preceding literature in section 3. The ensuing 4<sup>th</sup> section provides an introduction to the subset of the British Household Panel Survey used for this analysis. It also details the procedure by which we derive preference measures from regularities in prior behavior. The empirical strategy is discussed in section 5. Its results are subsequently presented in section 6, while section 7 concludes.

## 2. Measures of personality

From a psychological perspective personality research looks back on a long history (Barenbaum and Winter 2008). Measures of personality have become a standard tool within the discipline and have been applied in a wide variety of contexts (John et al. 2008). While a number of psychometric test batteries have been developed in order to capture various aspects of an individual's personality, the most commonly used taxonomy of personality profiles is the Five-Factor Model, also known as the Big Five (Digman 1990; McCrae and John 1992; McCrae and Costa 2008). Its name derives from the observation that factor analyses over the universe of human traits commonly yields five basic dimensions. Each of these five dimensions – commonly referred to as openness, extraversion, agreeableness, conscientiousness, and neuroticism – combines several more narrowly defined personality traits, and hence presents a measure for personality at the most abstract level. This taxonomy has been found to provide a remarkably reliable and valid picture of an individual's personality profile. For instance, self-assessed personality using the Big Five Inventory has been shown to be independent of cognitive ability and highly correlated to peer-assessed personality (McCrae and Costa 1987). Furthermore it has been found to be robust across different cultures (McCrae and Costa 1997) and comparatively stable over time (McCrae and Costa 1990; Roberts and DelVecchio 2000; Hampson and Goldberg 2006; Edmonds et al. 2013).<sup>3</sup> While it is impossible to predict behavior in any particular situation using its dimensions, they have been found to be reasonably reliable in describing behavioral trends across different situations and time (McAdams and Pals 2006; Boyce and Wood 2011).

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<sup>3</sup> Note that the true extent of temporal stability in personality traits is disputed (e.g. Caspi et al., 2005; Almlund et al., 2011). For a more in-depth discussion on the development, research, and criticism of the Five-Factor model, see Borghans et al. (2008a), and Almlund et al. (2011).

In detail these five key dimensions of personality include:<sup>4</sup> (1) Openness-to-experience entails the tendency to be open and sensitive to new aesthetic, cultural or intellectual experiences. (2) Conscientiousness is linked to the degree to which the individual is responsible, hard-working, and organized. (3) Extraversion describes the tendency to be outgoing, expressive, energetic and dominant. Individuals scoring high on this dimension also exhibit the tendency to actively seek and enjoy new experiences. (4) Agreeableness encompasses a number of traits that enable the individual to foster congenial relationships, and to behave cooperatively and unselfishly. (5) Neuroticism, finally, can be understood as the individual's degree of emotional instability and distress, which can also manifest in outer-directed hostility, anger, frustration and irritation.

### 3. Previous literature

An increasing empirical literature has reported that these measures of personality explain a significant part of heterogeneity in labor market outcomes. In particular, using the same data as we apply in this study, Heineck (2011) reports a wage premium for openness-to-experience and conscientiousness (only in females) between 3% and 4% and a wage penalty between 3% and 5% for the traits of agreeableness and neuroticism (only females). Almlund et al. (2011) survey the emerging literature. They report that conscientiousness is the personality trait with the highest predictive validity for educational attainment, achievement, and job-performance. Sorting into occupations is associated with most personality dimensions. This paper adds to this stream of literature by demonstrating that these non-cognitive skills are not only connected to labor market outcomes, i.e. how and how much individuals earn but also have a bearing on the way this income is distributed over expenditure categories. We, furthermore, take up the results from this stream of literature by assessing the extent of personality's indirect effects on demand behavior through income, educational attainment and health.

In analyzing the association between personality and expenditure behavior, this study also connects closely to a currently re-emerging debate in psychology and marketing. While such analyses look back on a long tradition in market research (Mischel 1968), this field of study was largely abandoned by the 1970s and only recently has been revived as a consequence of a more unified theory of personality in psychology (Bosnjak et al. 2007a). In the re-emerging literature, however, stronger focus has been put on the relationship between personality and modes and motives of buying, rather than on expenditure behavior *per se*. For instance, Bosnjak et al. (2007b) find that openness, agreeableness and neuroticism are important predictors of intentions to buy products online, and Verplanken and Herabadi (2001) show that extraversion and conscientiousness are important determinants of an individual's impulsive buying tendencies. Moreover, these studies are usually based on a questionnaire design and thus carried out with a very limited number of subjects. The present studies, thus, adds to this literature by highlighting the relationship between personality and expenditures *per se* for a representative sample of individuals.

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<sup>4</sup> This section relies heavily on Caspi et al. (2006). More detailed descriptions of the Big Five can be found there. For other more comprehensive descriptions see, amongst others, McCrae and Costa (2008) or Almlund et al. (2011).

This paper is furthermore associated with the literature linking personality and the consumption of addictive goods like alcohol and cigarettes. This literature commonly reports that alcohol consumption and smoking is associated with a personality profile characterized by low conscientiousness, low agreeableness and high neuroticism (see Malouff et al. 2006; 2007 for meta-analyses of the respective fields). In contrast to this line of research, we focus on the relationship between personality and non-addictive goods. Moreover, aside from assessing the conditional correlations between expenditure and aspects of personality, this study aims to understand the concrete channel by which personality dimensions affect expenditure behavior. In particular, we investigate whether the effect of personality on expenditures *ceteris paribus* can be understood as a result of omitting individual preferences from the estimation rather than as a discrete influence of personality itself. That is, we intend to answer the question if preferences and personality are complements or substitutes in predicting expenditure behavior.

In this sense the current paper is similar to the study by Becker et al. (2012) who analyze the relationship between measures of personality and preferences for a number of important life outcomes like income, subjective well-being, unemployment or health.<sup>5</sup> In particular, they assess the complementarity vs. substitutability of the Big Five and time, risk, and social preferences in explaining the heterogeneity of these outcomes. Using experimental as well as large survey samples, they find very low associations between psychological and economic measures, suggesting the presence of important complementarities. Unlike them, we focus on a set of narrowly defined goods, where the mapping of personality dimensions on preferences is comparatively straightforward. For instance, it is intuitively appealing to argue that an individual's preferences over leisure activities may be shaped to a substantial extent by her tendency to seek and enjoy new experiences, i.e. by a personality trait commonly known as openness-to-experience in psychology (cf. Caspi et al., 2005).

#### 4. Data and Descriptives

To investigate the relationship between personality and individual spending behavior, this study uses data from the British Household Panel Survey (BHPS), a longitudinal survey of individuals and their families living in the United Kingdom (for detailed information on the study, see also Taylor et al., 2010, on whom this description relies). Its objective is to trace economic and social changes in a representative sample of roughly 5,000 British households, amounting to about 20,000 individuals. Data collection is carried out annually since 1991 by the Economic and Social Research Council's UK Longitudinal Studies Centre (ESRC) in cooperation with the Institute of Social and Economic Research at the University of Essex.

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<sup>5</sup> Similarly, a number of studies implicitly assess the relationship between individual preferences and personality scores. Borghans et al. (2008b), for instance, find that at least for certain outcomes preference for leisure and personality traits simultaneously explain heterogeneity in responsiveness towards incentives while taking a test, also suggesting a complementary rather than a substitutive relationship between these concepts. However, they do not systematically analyze the effect of the inclusion of their preference measure on the point estimates for personality score, such that this evidence is rather tentative in nature.



We rely primarily on the 2005 wave (wave o) of the data set, which includes a set of items constructed to evaluate the respondents' psychological characteristics by providing the short 15-item version of the Big Five Inventory (BFI-S) (Gerlitz and Schupp 2005; Lucas and Donnellan 2010). In the BFI-S, each of the five personality dimensions is captured by three items, for which respondents rate their level of agreement on a seven point Likert scale. Answers range from 1 "does not apply" to 7 "applies perfectly". Identical to Heineck (2011), personality dimensions are obtained by generating the standardized average score from each sub-set of items.<sup>6</sup>

Like in most population wide panel surveys, expenditure behavior is not a key question of interest in the BHPS (Browning et al. 2003). Therefore information on consumption is provided for a limited number of items only. Note that this puts constraints on the overall generalizability of results beyond the observed goods. The main variables of interest in this study are personal expenditures on leisure activities (a), and on food consumed out of the home (b).<sup>7</sup> They are elicited using the following questions:

- (a) "Please [...] tell me about how much you personally spend in an average month on leisure activities, and entertainment and hobbies, other than eating out?"
- (b) "Please [...] tell me about how much you personally spend in an average month on eating out at, or buying take-away food from a restaurant, pub or cafe, including school meals or meals at work?"

Answers on both questions effectively track an individual's average monthly expenditure on a 13 point ordinal scale, with each step coding a censored interval spanning between 10 and 20 British Pound Sterling. They range from "nothing" (0) to "£160 or over" (12).<sup>8</sup> While a continuous measure of expenditure would certainly be preferable, no such information is available in the data. In fact, for various reasons, interval measurement is common in survey data (Stewart 1983; Bettin and Lucchetti 2012), and estimations based on interval-censored expenditure information have repeatedly been used in applied empirical research (e.g. by Guariglia and Rossi 2002; Smith 2006). To account for this kind of censoring we apply two different estimation strategies, which will be discussed in more detail below.

Aside from issues of generalizability, another drawback of using expenditures on leisure and food away from home for the present purpose arises from the way decisions on these consumption activities are reached by the individual. Both pastimes are likely to be joint activities of all household members (Kalmijn and Bernasco 2001; Voorpostel et al. 2009). Hence, despite the fact that measurement items ask for personal expenditures, answers to these questions are likely to be correlated among members of the same household. In fact,

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<sup>6</sup> In order to increase the internal consistency, and thus reliability, of personality measures not all items were included in this procedure. As already demonstrated by Heineck (2011), the negatively worded items for measuring agreeableness, conscientiousness, and extraversion reduce the internal consistency of the personality measure, even after reversing the score. Accordingly, these items are dropped from the analysis. Estimations of the Cronbach's alpha (Cronbach 1951) yield internal consistency coefficients of 0.68, 0.67, 0.67, 0.64, and 0.62 for openness, neuroticism, extraversion, conscientiousness, and extraversion, respectively.

<sup>7</sup> A further, similarly measured expenditure category, namely on food consumed in the household, is also available in the BHPS. We refrain from using this category because the corresponding question is framed with respect to household rather than personal expenditures.

<sup>8</sup> A more comprehensive description and descriptive statistics is given in Table A1. in Appendix A to this paper.

prior studies using the same data set have found substantial evidence for the alignment of leisure and dining activities among members of the same household (Volland 2013). Hence, observations stemming from the same household are unlikely to be independent of each other. To avoid issues of inter-dependency in the data, the sample is split and we estimate the relationship between personality and spending for primary male and primary female respondents separately.<sup>9</sup> Another reason for separating the sample by sex is that the effect of personality traits on other economically relevant outcomes like wages and on social preferences has been reported differ between men and women (Heckman et al. 2006; Heineck 2011). A Chow test (Chow 1960) also suggests that there are significant differences between the coefficient estimates of the male and the female sample. Histograms showing the distribution of expenditures for both male and female subsamples are given in Figure 1.

*Insert Figure 1. about here*

Before detailing the research strategy, we turn to a brief exposition of further control variables. In accordance with the standard approach to demand behavior, the most important control variable is the natural logarithm of the respondent's equivalized household income in the month prior to the interview (in British Pound Sterling). Preliminary analysis was conducted using McClement's (1977) equivalence scales both before and after housing costs. Since both methods yield almost identical results, the estimations presented in the following section are based on the "after housing cost" measure.

Further controls contain the respondent's age and age-squared in years, a set of dummies specifying her level of education (which aim to partially capture the individual's cognitive capacities), her current state of self-assessed health and a set of dummies indicating the type of household in which she lives. Additionally, controls encompass one dummy on whether the person is currently a smoker, one dummy on the individual's race, the number of children currently living in her household, and the number of hours which the person usually works per week (including overtime). This final control accounts for the fact that working hours may curtail the time available for the respondent to engage in leisure activity choices, but may increase the need to consume food away from home. Together, these variables present the baseline specification for the empirical analysis.

A second specification additionally includes a set of 47 dummies indicating the region-month in which the interview was conducted. That is, for each of the 12 regional entities, we separately create a set of dummies indicating the month in which the respondent participated in the survey. This specification is informative since variations in expenditures across

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<sup>9</sup> Primary respondents are defined as being either the reference person or his/her lawful spouse or live-in partner as classified in the data. Note that in the presence of leisure activity alignment within the household, estimations on the relationship between personality and spending behavior are nevertheless affected by measurement error, even when segregating the sample by sex. If spending decisions are taken jointly (and personality traits differ) within households, an individual's spending behavior may partly be guided by other persons' traits. To check whether such influences substantially distort results, we ran additional estimations focusing on individuals living by themselves. These exercises produce results largely corresponding to the ones presented below.

individuals may also be driven by unobservable spatial and temporal variations (e.g., in prices) or the self-selection of personality types into the rural-urban continuum. Note that in the 2005 wave almost 95 percent of all interviews are carried out in the final third of the year. In order to allow for sufficient variation in behavior within each region-month, observations from interviews conducted earlier in the year are dropped from all estimations. Further observations are removed by trimming the highest and the lowest percentile of the income distribution in order to reduce the impact of outliers. Finally, we restrict estimations to individuals providing full information on all relevant variables. Hence, estimations on leisure expenditure are based on 4,684 men and 5,964 women, respectively. Estimations on the expenditures for food away from home use information from 4,704 men and 5,969 women.<sup>10</sup>

*Insert Table 1. about here*

Table 1. presents an overview of the descriptive statistics for both sub-samples analyzed in this study. In accordance with previous psychological research (Costa et al. 2001; Schmitt et al. 2008) women score higher than men on neuroticism, extraversion and agreeableness, and report slightly higher levels of conscientiousness. In accordance with economic expectations, men report higher levels of educational attainment, higher weekly working hours, and consequently higher household incomes.

Since we are also interested in the relationship between psychological personality measures and economic preference parameters but only the prior is readily available in the BHPS, it is necessary to construct a measure of the latter. Towards this end, we follow the literature on inter-generational transmission in consumption preferences (Walckirch et al. 2004; Volland 2013) making use of the initial panel structure of the data. This data provides information on behavioral regularities prior to the 2005 wave. In particular, we use information on the frequency of dining and leisure activities in the years before 2005.<sup>11</sup> Information on behavioral frequency is provided biannually in the BHPS. Frequency of execution for activities is measured on a 5-point ordinal scale, where a value of one implies that the respondent never or almost never executes an activity, and a value of five implies that the respondent executes this activity at least once a week.<sup>12</sup> However, observable behavior is likely to be determined by other factors like prices, life-cycle, business cycle, and regional effects, which put constraints on both the possibility and the necessity to consume food outside the household or to engage in leisure activities. We therefore first regress behavioral frequency of dining and leisure activities on life-cycle (age, age squared, equivalent

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<sup>10</sup> Differences in sample sizes between male and females reflect both differences in the composition of the original sample as well as sex-related sample attrition (pre-dominantly male) which has been reported for the BHPS (Taylor et al. 2010). Results based on the entire sample yield very similar results. They are available from the author upon request.

<sup>11</sup> We consider the frequencies of “having a meal at the restaurant, café, or pub” and “having a drink at the pub or club” as a basis to obtain preference measures for food outside the house, and the frequencies for “watching live sports”, “going to the cinema”, and “going to a concert, theatre, or live performance”. Raw preference measures are obtained by standardizing the sum of behavioral frequencies for each category.

<sup>12</sup> Note that the original coding in the BHPS differs, with high numbers indicating a low frequency of behavior. This order was reversed. Concrete values are: (1) Never/ almost never, (2) once a year or less, (3) several times a year, (4) at least once a month, and (5) at least once a week.

household size, and household type dummies), business cycle (year dummies, a dummy set indicating current economic activity) and regional dummies. These auxiliary regressions yield corresponding residuals that are orthogonal to these effects. Preference proxies are then obtained by averaging these residuals over the years in which the data are available, in order to reduce the potential influence of measurement errors.<sup>13</sup> Only information from waves conducted prior to 2005 was used in to derive preference measures. Table 2. presents the descriptive for these preference measures.

*Insert Table 2. about here*

## 5. Research strategy

As noted earlier, one of the difficulties in dealing with expenditure data as provided in the BHPS is that this information is only given in bins spanning ranges between £ 10 and £ 20. Hence, dependent variables are partially censored, and the exact amount of spending  $y_i^*$  is not observable. Instead, we observe the interval  $[m_i, M_i[$  into which the true value falls:  $m_i \leq y_i^* < M_i$ .<sup>14</sup>

As a consequence, the data generating process

$$y_i^* = x_i' \beta + \varepsilon_i, \quad (1)$$

cannot be modeled directly but has to be approximated. One frequently chosen possibility is to use the midpoint of each interval  $\tilde{y}_i = \frac{m_i + M_i}{2}$  as a proxy for the true expenditure  $y_i^*$  (e.g. by Guariglia and Rossi 2002; Smith 2006), and to correct for the arising heteroskedasticity problem by robust estimations of the covariance matrix (Bettin and Lucchetti 2012). We adopt this strategy as a benchmark using OLS regression and assigning a value of £ 190 to the highest expenditure category for both goods. The advantage of this procedure is that it is straightforward and inexpensive.

However, as the error term of equation (1),  $\varepsilon_i$ , is extended by the unobservable difference between between the true expenditure value,  $y_i^*$ , and its proxy,  $\tilde{y}_i$  (i.e., the true error term is given by  $\zeta_i = \varepsilon_i + y_i^* - \tilde{y}_i$ ), this estimation strategy can lead to seriously inconsistent estimates and considerable inference errors (Stewart 1983). Extensive Monte Carlo simulation has demonstrated that inference errors become more severe, the further the distribution of the error term deviates from normality (Stewart 1983; Bettin and Lucchetti 2012). To control for the extent of these errors in the benchmark estimations, we therefore additionally apply

<sup>13</sup> An alternative to this procedure is to substitute information on lagged expenditure for information on behavioral frequency. For reasons detailed more comprehensively elsewhere (Volland 2013) we believe that information on activity choices is advantageous when trying to elicit the preference component of behavior in survey data. However, experiments (a) substituting activity choice by lagged expenditures and (b) using lagged expenditure directly yield results very similar to the ones presented below.

<sup>14</sup> The two exceptions to this rule are (a) the largest interval which is right-unbounded and (b) the smallest interval which is uncensored, such that  $y_i^* = m_i = M_i = 0$ .

Stewart's (1983) interval regression to the lower and upper bound of the expenditure intervals. Under the assumption of normality of the error term, the log likelihood function for any one observation is then given by:

$$LL_i = \ln P(m_i \leq y_i^* < M_i) = \ln \left[ F \left( \frac{M_i - x_i' \beta}{\sigma} \right) - F \left( \frac{m_i - x_i' \beta}{\sigma} \right) \right]. \quad (2)$$

In equation (2),  $\beta$  and  $\sigma$  parameters are obtained by maximizing the total log likelihood over all intervals and for all observations using standard linear programming methods (Stewart 1983; Bettin and Lucchetti 2012).<sup>15</sup> Another advantage of this estimator is that it is able to deal with the right-censoring of expenditure data, where only the minimum monthly expenditure is measured. To obtain more accurate results, we base statistical inference for both estimators on standard errors robust to heteroskedasticity at the regional level.<sup>16</sup>

Since we estimate the relationship between current expenditures and current personality traits, the coefficients correspond to associations between variables, rather than being informative about the causal relationship between these variables in any strict sense. However, an additional set of estimations relating personality traits measured in 2005 to expenditure behavior measured in 2008 yields virtually the same results. While with these exercises it is impossible to tackle all problems of simultaneity, they nevertheless demonstrate that reverse causality, i.e. current expenditure patterns driving current personality traits are unlikely to explain our results.<sup>17</sup>

## 6. Results

### 6.1. Direct effects of personality

Tables 3. and 4. provide estimates from the OLS regressions on the mid-points of the observed expenditure intervals as well as from the interval regression (INTREG) on the upper and lower bound of the observed interval, separately for men and women.<sup>18</sup> Table 3. gives the

<sup>15</sup> Results from Monte Carlo simulations reveals that, unlike the use OLS estimators on the midpoint of each interval, results obtained when applying the interval regression estimator are robust to deviations from the assumed distribution of the error term (Stewart 1983; Bettin and Lucchetti 2012).

<sup>16</sup> Empirical investigations are carried out in Stata 11 using the *intreg* command.

<sup>17</sup> The results are available from the author upon request. Note that the implicit assumption of these estimations, namely that personality traits are reasonably stable over short periods of time, is generally supported by economic and psychological literature, independent of their stance concerning the long-term stability of personality (McCrae and Costa 1990; Caspi et al. 2005; Borghans et al. 2008a; Almlund et al. 2011). In order to address potential simultaneity problems further, we have tried to instrument personality traits using available information like parental background (e.g. parents' educational attainment and living conditions), the respondent's physical characteristics (e.g. height) and family structure (position in the line of siblings). None of these experiments, however, yield plausible results.

<sup>18</sup> Results are robust to a number of other estimation techniques. Particularly, we applied Zellner's (1962) seemingly unrelated regression approach, to accommodate for the possibility that decisions on expenditures on leisure and on food away from home are not taken independently by the individual. Moreover, we address the problem that the obtained personality scores imperfectly measure underlying true traits. To correct for this kind of measurement error we apply the errors-in-variables (EIV) estimator, using the earlier obtained internal consistency coefficients as weights in a weighted regression, correcting simultaneously for attenuation in point estimates and in standard errors (for an extensive discussion, see Kmenta, 1997: pp. 352-357). Additionally, we use zero inflated negative binomial regression and Heckman (1979) two-step estimators as Figure 1 suggests that expenditure behavior might be driven by two different processes (selection variables are assumed to include the natural logarithm of equalized household income, the number of own children, the highest educational attainment of the respondent and her parents, the type of household in which the respondent currently lives, as well as the

results for expenditures on leisure activities, while Table 4. provides the results from estimations on expenditures for food consumed outside the home. Both estimators yield virtually identical results, i.e. size, signs, and statistical significance of coefficients lead to very similar conclusions. Therefore, only the results obtained from interval regression are discussed. Similarly, few differences can be observed between specifications including and excluding the additional set of region-month dummies, suggesting that unobserved temporal and spatial variations (e.g. in prices) are unlikely to confound the observed relationship between expenditures and personality.<sup>19</sup> The following discussion is based on the results from specifications including these dummy sets. Finally, in order to economize on space, coefficients of all other controls are not displayed. Full estimation results are available upon request.

*Insert Tables 3. and 4. about here*

In general, results suggest that, everything else being equal, aspects of personality have a modest but non-negligible effect on expenditure behavior. In particular, we find that one standard deviation increase in extraversion corresponds to an increase between £ 3.18 (leisure activities, female sub-sample) and £ 6.80 (leisure activities, male sub-sample). That is, a value corresponding to between 8% and 13% of the respective sub-sample mean (measured at the mid-points of the expenditure intervals). Yet, bearing in mind that the psychological trait of extraversion describes an individual's disposition towards social interaction and contact (cf. Caspi et al. 2005), the particular strength of these associations may not be entirely surprising. As most leisure activities are of an inherently social nature and commonly exercised together with others, a person who scores higher on this trait may have been expected to be more likely to engage in these activities, and hence spend more on them. The same holds for the consumption of food away from home.

Similarly, we find that individuals exhibiting higher levels of openness also show higher expenditures for leisure activities (both men and women) and food away from home (only men). Since openness-to-experience measures the individual's tendency to seek stimulation and to explore novel environments actively (Caspi et al, 2005), this result also seems intuitive.<sup>20</sup>

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number of books and the urbanity of the respondent's parental household when the respondent was 15 years of age). Finally, following Heineck (2011) we control whether unobserved heterogeneity may bias the obtained estimates. We therefore make use of the data's panel structure and (assuming that personality profiles remain invariant over time) estimate both random effects and Hausman-Taylor IV regressions (assuming that the individual's race and personality scores to be time-invariant and exogenous, year, month and geographic location of the observation to be exogenous and time-variant, while all other variables are assumed to be endogenous). All these techniques yield virtually the same results.

<sup>19</sup> Nevertheless, log likelihood estimates suggest that the inclusion of these measures substantially improves model fit.

<sup>20</sup> Note that coefficient estimates for openness to experience are higher and their statistical significance more pronounced in estimations on leisure activities than in estimations on food consumed away from home. This may be due to the fact that the latter category also comprises food consumed in cantinas, whose demand will be driven by basic nutritional requirements rather than by a generally positive and curious attitude towards new experiences.

What is more surprising is the comparatively strong negative relationship between agreeableness and the two expenditure categories. In particular among men, a one standard deviation increase in agreeableness is associated with a decrease in expenditure for both categories corresponding to around 5% of the sample mean. As agreeableness is commonly linked with an individual's sociability (Graziano and Eisenberg 1997), this finding is counterintuitive because one would expect a more agreeable individual to also engage stronger in social activities like dining out or going to a concert. However, while the trait of agreeableness is generally associated with a tendency to foster congenial relationships, it has also been linked with the individual's ability to execute self-control (Olson 2005). Psychological research shows that more agreeable individuals generally show a track record of higher levels of self-control (Laursen et al. 2002). Hence, individuals scoring high on the dimension of agreeableness may also be more self-controlled, suggesting that they would be more likely to forestall the satisfaction of a current desire for the sake of long-term goals. Thus, these individuals might well be willing to sacrifice a late-night dinner at an expensive restaurant or a night out at the pub in order not to be late for work or show up sleep-deprived at class.<sup>21</sup> It is noteworthy, that the association between agreeableness and expenditures for both goods is substantially weaker and among women than among men.

Gender differences can also be found for the relationship between neuroticism and expenditures. While we find no evidence for such a relationship among men, in women a one-standard deviation increase in this trait is accompanied by drops in expenditure of roughly £ 1.50 (i.e. just over 4% of each sub-sample mean). Hence, women who are more susceptible to emotional instability and psychological distress are less likely to engage in these consumption behaviors. While we have no explanation for these differences along gender lines, these results fall in line with a stream of previous research showing that neuroticism is a stronger predictor of behaviors among women than among men (see, e.g., Ben-Ner et al. 2004 for the case of voluntary giving or Heineck 2011 for gender differences in the association between neuroticism and wages).

Finally, we find little evidence for an effect of conscientiousness on monthly spending in both expenditure categories. The sole exception is leisure expenditures among females, for whom each standard-deviation rise in conscientiousness is associated with a drop in expenditures corresponding to 5% of the sample mean. This finding is somewhat at odds with the results from the literature linking personality and alcohol consumption, which reports that conscientiousness is an important predictor for these behaviors (Malouff et al. 2007). As alcohol consumption is at least partially included in our measure of food consumed away from home, it might have been expected to find a similar result for this category. However, in its broad majority this literature focuses on problematic patterns of alcohol consumption, which represent a minority of cases in overall alcohol demand. Hence, our results may indicate that problematic vs. non-problematic alcohol consumption may be associated with different personality profiles rather than with differences in the expressivity of single traits.

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<sup>21</sup> Similarly, psychological research on smoking and alcohol consumption (Malouff et al. 2006; 2007 for meta-analyses of the respective fields) also finding a negative relationship between agreeableness and these activities, has argued that this link is likely to reflect individual differences in the ability to exercise self-control.

In summary, aspects of personality are significantly correlated with the demand for food away from home and other leisure activities. The predictive validity of personality dimensions – as measured by the percentage change in expenditure associated with a one standard deviation change in personality traits – is comparable to those of other relevant determinants of demand (not reported but available upon request). For instance, assuming that the marginal effect applies to the entire range of possible answers, a one standard deviation increase in health is associated with increases in expenditure between £ 1.17 (food away from home, females) and £ 3.54 (food away from home, males). These are values corresponding to between 3% and 7% of the respective sub-sample's mean expenditures. Note that one standard deviation in health roughly corresponds to one step on the original 5 point ordinal scale (compare Table 1.). Hence, the change in expenditures associated with a one standard deviation change in any significant personality dimension is comparable to a change associated with moving one step on the five-point subjective health scale (e.g., from fair to good). Similarly, the point estimates for weekly working hours indicate that the change in expenditures associated with a one standard deviation change in this control is comparable in size to the change associated with a one standard deviation change in the significant personality predictors. To put these figures into perspective, being non-white is associated with a decrease in monthly leisure expenditures of about £ 10 in both women and men.<sup>22</sup> Hence, a change in such a fundamental characteristic is equivalent to changes between 1.5 standard deviations (extraversion, males) and 7.7 standard deviations (neuroticism, females) of each single personality trait. Hence, personality seems to have a modest but clearly non-negligible impact on expenditure behavior. What is more, the effect sizes we report are very similar to the ones presented in the previous literature on the association between personality traits and wages, as well as personality and employment status (Heineck 2011, Fletcher 2013), albeit the relevant personality dimensions differ.

## 6.2. Personality, preferences and expenditures

Results from the preceding section indicate that, all else being equal, there is a modest yet non-negligible association between an individual's personality and her expenditures on leisure activities and food consumed away from home. However, this finding is compatible with two different hypotheses. On the one hand, it could be indicative of a discrete influence of personality as a behavioral constraint. On the other hand, correlations may also be ascribed to the omission of independent preference measures from the specification. As discussed earlier, recent literature has argued that assessments of personality dimensions might be used as a proxy for preferences in analyses of economic behaviors and outcomes (Caplan 2003; Almlund et al. 2011). In this section we aim to understand to which extent this claim is valid in the context of expenditures for leisure and food away from home. We therefore proceed in two steps. First, we determine the magnitude of correlations between measures of personality and measures of preferences. Second, we extend the exercise from Tables 3. and 4., by including an independent measure of preferences in the demand equations. The rationale behind this approach simply is that if preferences and personality traits are closely linked

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<sup>22</sup> We find no significant correlation between race and food consumed away from home.



including both to the estimation should substantially alter size of the personality coefficients, while leaving the variance explained by the model largely unaffected.

Tables 5. displays the raw correlation structure of personality traits and these empirically derived preference measures in the male and female sub-sample, respectively. Unlike Becker et al. (2012) we find that a majority of these correlations is statistically significant at commonly accepted levels of error, indicating a certain degree of congruence between personality and preference measures. However, given the considerable number of observations in each sub-sample these results need to be treated with caution. As none of the correlation coefficients exceeds 0.2, the overlap indicated by them is likely to be small, despite of their statistical significance. Moreover, when considering linear, quadratic or cubic mapping of personality on preferences (i.e., regressing preferences on linear, quadratic or cubic specifications of the personality traits),  $R^2$  does not exceed 7%. Thus, there is also no indication for a stronger nonlinear connection of these concepts, suggesting a complementary rather than a substituting relationship.

*Insert Table 5. about here*

The finding that there is only a small correlation between preferences and each single personality score does not necessarily imply that an individual's personality is unrelated to her preferences. Since the five factor model measures orthogonal dimensions of personality (McCrae and Costa 1990; 2008), the separate correlations of these dimensions may add up to jointly explain a non-negligible part of the individual's preferences. To explore this issue further, we extend the exercise from Tables 3. and 4., by regressing demand jointly on personality scores and preference proxies and analyzing the corresponding changes in point estimates and explained variance. In the following we limit the discussion to the results from the OLS estimations, as they allow for an easy interpretation of obtained  $R^2$  values. Table 6. present these results. For each sub-sample and expenditure category, it gives the coefficients from specifications including and excluding the relevant preference proxy. Additionally, it provides the difference in coefficients between these specifications, where  $\Delta = \beta_{\text{excluding preference proxy}} - \beta_{\text{including preference proxy}}$ . We apply a series of Wald-tests to assess whether these differences are significantly different from zero. Corresponding results obtained by interval regression can be found in Table A3. in Appendix A.

*Insert Table 6. about here*

The most eye-catching feature of Table 6. are the comparatively big point estimates of the preference proxies, which exceed the estimates for personality scores by a factor 20 or more. While these point estimates demonstrate that our preference proxies contribute substantially to

explaining the heterogeneity in expenditure behavior, caution is advised when interpreting their size. As preference proxies are derived from the residuals of auxiliary regressions, their distributions are centered around zero with standard deviations between 0.11 and 0.16 (compare Table 2.). Hence, a change of one unit in the preference parameter roughly covers the entire range of these measures, such that the point estimates presented in Table 6. specify the change in expenditures associated with moving from an individual in the far left tail of the preference distribution (one least liking the good) to an individual in the far right tail (one most liking the good). Moreover, in particular for leisure expenditures the range of preference parameters can be smaller than one, further complicating the interpretation of the preference coefficients.<sup>23</sup>

More importantly in the light of the current research question, a first inspection of the point estimates presented in Table 6. reveals substantial changes in the coefficients of personality dimensions as a result of including independent preference proxies. Most estimates in these specifications appear closer to zero as compared to specifications not including these proxies, suggesting that in the absence of adequate preference measures, estimations aiming to assess the impact of personality scores on demand outcomes are likely to suffer from omitted variable bias. In particular, we find that across samples and expenditure categories, the inclusion of preference measures decreases the size of coefficients of extraversion decrease by 13 to 58 percent. Similarly, point estimates for neuroticism drop by roughly 20 percent for both expenditure groups among the female sub-sample, and estimates of openness in leisure regressions decline by 28 percent in women and 38 percent in men (where the coefficient becomes statistically indistinguishable from zero). Results from the ensuing Wald-tests demonstrate that these differences in coefficients are significant at the 1% level. Hence, there is evidence that personality and preference measures are not completely independent. In particular, preferences for both leisure and food away from home seem to relate to an individual's tendency to seek and enjoy new experiences (i.e., extraversion). Moreover, preferences for leisure activities also seem to be associated with the degree by which the individual can be described as imaginative, creative and aesthetical sensitive (assessed by her degree of openness). And finally, women's emotional stability – as measured by the degree of neuroticism – also seems to overlap with their preferences for both goods under consideration. Thus, there is evidence for a certain degree of overlap of preference and personality measures in explaining expenditure behavior for leisure activities and food away from home.

However, it is important to note that with one exception – i.e., the coefficient of openness in leisure activities demand among men – including preference measures does not render the associations between personality traits and expenditure behavior obtained in Tables 3. and 4. insignificant. Moreover, some previously insignificant relationships turn significant when including preference proxies. In particular, conscientiousness becomes a significant predictor of male demand for food away from home, and neuroticism becomes significantly associated to leisure expenditures in the same sub-sample. Hence, while there is undoubtedly a certain

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<sup>23</sup> A more credible impression of the predictive importance of preference measures can be obtained by looking at the changes in expenditure corresponding to a one-standard-deviation change in preference measures. In the male sub-sample these values correspond to £9.17 (leisure) and £13.48 (food away from home). These values are equivalent to 17.8% and 24% of the sample means. In the female sub-sample they are £5.82 (leisure) and £7.81 (food away from home), thus corresponding to 18.7% and 21% of each sample mean.

degree of congruence between these concepts, the degree of overlap is limited. More importantly, these results demonstrate that, despite the intuitive similarity between preferences and personality traits in the special context of leisure expenditures, there are in fact important complementarities between these concepts. Hence, heterogeneity in preferences is captured only partially by personality measures, suggesting that using latter to proxy the former might lead to substantial inference errors.

This interpretation is substantiated by comparing of goodness-of-fit measures. Including preference proxies into the baseline specifications yields substantial increases in adjusted  $R^2$  values ranging between 2% (leisure activities, females) and 6.7% (food away from home, males). Moreover, specifications including preference proxies have considerably higher log-likelihood values than specifications lacking this control. Thus, the additional explanatory power in these proxies is sizeable, also suggesting crucial complementary relationships between measures of personality and preferences in explaining the demand for leisure activities and food away from home. These results are consistent with the ones found by Becker et al. (2012) for the relationship between personality and preferences over time and risk, as well as social preferences.

### 6.3. Indirect effects of personality

The results from the preceding sections suggest that while there is a significant relationship *ceteris paribus* between personality traits and expenditure behavior, the effect size implicated by this relationship is modest. One of the reasons for this finding may be that rather than affecting expenditure behavior directly, personality indirectly shapes consumption decisions by influencing other outcomes which in turn bear on the willingness or ability to demand certain items. Previous research has for instance shown that differences in personality explain some of the inter-individual differences in educational attainment, health, and earnings (for a comprehensive overview of the literature linking personality to these outcomes see Heckman et al. 2006; Almlund et al. 2011; Becker et al. 2012). Since these characteristics have been reported to influence demand for leisure activities (e.g. by Dardis et al. 1994 and Robinson and Godbey 1997),<sup>24</sup> the results presented in Tables 3. and 4. may underestimate the true impact of personality on consumer decisions.

In this section we set out to investigate to what extent these socio-economic characteristics indeed confound the relationship between personality and expenditure, thus providing an indication for potential indirect effects of personality on expenditures. Therefore, we conduct linear regressions removing income, health, and educational attainment in turn from the set of control variables, in order to analyze the changes in personality coefficients conditional on these changes in specification.<sup>25</sup> These analyses provide information on the extent to which

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<sup>24</sup> We also find significant and substantial correlations between these variables and expenditure behavior in our data.

<sup>25</sup> An alternative procedure is to estimate the full derivative of expenditures with respect to personality, accounting for the indirect effects of personality on expenditures, using auxiliary models that predict education, health status and income (MacKinnon et al. 1995; 2002, for an example from the area of health economics see Han et al. 2009). For various reasons we abstain from this procedure. First, since we are interested in the indirect effects of five characteristics and would need to consider a number of intervening relationships among at least five socio-demographic controls, displaying the full results

the effects of personality traits on demand behavior are confounded by any of the above mentioned socio-demographics. They thus give an impression of the size of potential indirect effects of personality on demand as mediated by any of these socio-demographics in isolation. Relevant health variables include self-assessed health and smoking behavior, while income variables encompass equivalized household income and average weekly working hours. Educational attainment pertains to the set of dummy variables designating the highest level of education achieved by the respondent.

In an additional step we exclude health, education and income variables together. This analysis is informative because an individual's income, educational attainment, and health are correlated, such that the variation of any of these three characteristic might essentially be picked up by the remaining ones. These correlations are not coincidental. It has, for instance, been shown that there are substantial inter-dependencies between income and health and that both are affected by the individual's educational attainment (see, among others, Case et al. 2001; Cutler and Lleras-Muney 2006). As a result, the indirect effects of personality on expenditure may still be underestimated when only accounting for its effect through any of the three socio-economic characteristics in isolation, as real world relationships are likely to be more complex. For example, personality may affect educational attainment, which in turn may bear on expenditures (a) directly, (b) through income, (c) through health, and (d) through the effect of health on income. Yet, removing only educational attainment from the controls can account for channel (a) alone.

*Insert Figure 2. about here*

Figure 2 presents the regression coefficients of the five dimensions of personality conditional on the underlying specifications. Results are separated by the two goods and the respondent's sex, respectively. They show that the exclusion of each single socio-economic trait in isolation yields only small changes in the estimates of the personality dimensions. A series of ensuing Wald tests demonstrates that these changes are rarely significantly different from zero, particularly after applying Bonferroni correction to confidence levels in order to account for the 80 individual Wald-tests performed. Thus, we find little evidence that the relationship between an individual's personality and her leisure expenditure behaviors is confounded substantially by any socio-economic characteristic in particular.

However, excluding health, income, and educational characteristics together results in a number of noticeable changes in the point estimates of personality scores. These changes are

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from such an exercise would be tedious and complicated. This problem would be exaggerated by the fact that we do not have one continuous measure of education but have to rely on a dummy set encompassing 13 variables. Second, in the absence of suitable instruments, auxiliary regressions are likely to suffer from substantial endogeneity bias, raising doubts about the reliability of these estimates. Finally, psychometric research has shown that "the difference of coefficients approach" we apply and the alternative "product of coefficients approach" briefly discussed here yield highly similar results (MacKinnon et al. 1995; 2002). Table B1 in Appendix B presents the results from such an exercise relying on an ordinal measure of educational attainment and focusing on the relationship between household income, subjective health and this measure of education alone. These do not lead to different conclusions from the ones presented here.

most pronounced for the traits of openness-to-experience and neuroticism whose coefficients become considerably bigger. On average – over both sub-samples and goods – coefficients for openness-to-experience increase by a factor 2.7 (corresponding to an additional £ 1.75 increase in expenditures for a one-standard deviation increase in openness), while point estimates for neuroticism expand by a factor 1.8 (tantamount to a further £ 0.93 decrease in expenditures for each one-standard deviation increase in neuroticism). Hence, roughly one-half to two-thirds of the true effect of these personality traits on demand might be mediated by the relationship between an individual's personality and her socio-economic characteristics. These findings are congruent with previous research showing that openness tends to have positive effects on educational attainment, income and health, while neuroticism is negatively associated with each of these outcomes (see, e.g., Heineck 2011; Almlund et al. 2011; Becker et al. 2012).

None or much smaller changes in coefficient size can be observed for the personality dimensions of extraversion, agreeableness and conscientiousness. Moreover, if changes occur they are significant for a limited number of sub-samples only. For instance, changes in the coefficient size for agreeableness are only significant for women, while changes in the coefficient size of conscientiousness are observable solely for expenditures on food consumed away from home. Hence, results suggest no systematic mediating effect of health, educational attainment and income for the relationship between these personality dimensions and expenditures.

## 7. Summary and conclusions

While the importance of personality and other non-cognitive skills for understanding differences in labor market outcomes has come to be increasingly appreciated by economic scholars (cf. Borghans et al. 2008a; Almlund et al. 2011), little research has so far focused on the question whether these measures also explain some of the individual heterogeneity in demand behavior that usually goes unaccounted for in economic analysis. Using data from the BHPS, this study provides evidence for the relationship between the Big Five personality traits and expenditures for food away from home and other leisure activities. Additionally, it focuses on the channel by which personality influences expenditure patterns. We find that extraversion (men and women) is positively related to expenditure for both goods under consideration, while neuroticism (only among women) and agreeableness (only among men) reduce expenditures on them. Openness-to-experience increases the demand for leisure activities in men and women, but not for expenditures on food away from home. Interestingly, there is no convincing evidence for an association between conscientiousness and expenditures for these goods, despite the fact that this personality dimension is among the most important predictors in labor economics and health behavior literatures.

Further analysis reveals that the relationship between these personality dimensions and expenditures cannot be explained by the omission of preference measures, as including them changes the size of most estimates only slightly. While we can reject the hypothesis that personality and preferences are perfectly orthogonal, the overlap identified in this study is

limited, suggesting important complementary relationships between these measures. More importantly, our analysis shows that the assumption that dimensions of personality might be used to proxy unobservable heterogeneity in preferences cannot be supported by the data. These results strongly reinforce the findings of Becker et al. (2012), who also find little overlap between personality measures and preferences over time, risk and social matters. Together these results suggest that despite their intuitive similarity (in the context of leisure expenditures), economic measures of preferences and psychological measures of personality seem to capture distinct influences on the individual's choice process.

As Becker et al. (2012) point out this may not be entirely surprising. For one, the comparatively broad psychological concept of personality dimensions as assessed by the Big Five Inventory not only includes components of preferences, but also comprises beliefs and constraints. Thus personality dimensions might be combining concepts that are considered distinct in economic theory. The trait of conscientiousness, for example, encompasses both the ability and the willingness to work hard, self-disciplined and well-organized, thus comprising aspects of personal abilities and aspects of preferences. However, recall that unlike Becker et al. (2012), we derive our preference proxies from auxiliary models, isolating the component of prior behavior unexplainable by life-cycle, business cycle and regional effects. Hence, our preference proxies are broader than the ones used in their study, and are likely to contain some of the unobservable inter-individual variation in beliefs and abilities as well. Yet, despite these differences in constructing preference measures, the results concerning the relationship between preferences and personality dimensions are remarkably similar. This indicates that the broadness of measured personality traits as compared the preferences is likely to play a minor role in explaining the overall weak correlation between them. However, further research assessing the relationship between constraints, beliefs, preferences and personality traits is no doubt necessary.

Another reason for finding only limited overlap between preferences and personality traits may arise from the fact that the Big Five dimensions present a measure of personality at the most abstract level. Thus, stronger relationships at the level of more narrowly defined traits may become essentially blurred by aggregating them to a higher level dimension. Pauonen and Ashton (2001), for instance, show that allowing for more fine-grained measures of an individual's psychological profile can substantially improve predictions and increase explained variance for a wide variety of behaviors. Indeed, experiments (not reported) substituting the original 15 items from the BFI-S for the five factors derived from them yields substantial increases in model fit (as measured by Akaike and Schwartz Information Criteria), indicating that there are likely stronger connections between sub-facets of the Big Five and expenditure behavior. However, estimates for those items also remain largely unaffected by the inclusion of preference proxies, reinforcing the initial finding concerning the relationship between personality and preferences. While this is admittedly a blunt test, as we cannot exclude that there exist stronger relationships between preferences and more comprehensively measured lower-level facets of personality, it nevertheless provides a first indication that preferences and more narrowly defined personality traits may not be closer related than the ones reported for the Five Factor Model.

All in all, these results suggest that the fundamental finding from personality psychology that the entire universe of human traits can be reduced to five basic dimensions is of limited value in accounting for individual heterogeneity in preferences. Moreover, even if stronger relationships between preferences and sub-sets of these personality dimensions could be identified, the question remains whether measuring preferences based on “thousands of ways that individuals vary” (Caplan 2003: p. 395) is a practical solution for applied empirical research. Especially, as more extensive instruments assessing personality profiles like multi-source, multi-method approaches are unfeasible in the context of representative, large-scale data sets commonly applied in economic demand analysis (Borghans et al. 2008a). Hence, further research and other approaches to explaining individual differences in preference patterns are needed, in order to overcome the assumption of preference homogeneity in this line of research. Recent theoretical contributions in this domain, using a need-based approach to preference formation have been shown to be successful in explaining a number of well-known phenomena like decreasing income elasticities as a result of rising incomes (Witt 2001; Lades 2013).

This is not to say that Big Five personality traits are of no use to empirical demand analysis. To the contrary, our results clearly indicate that *ceteris paribus* these characteristics explain a non-negligible part of expenditures on food away from home and leisure activities. That is, we find substantial associations between personality traits and expenditures even when controlling for other individual characteristics which have also been shown to be affected by these traits (cf. Borghans et al. 2008a; Almlund et al. 2011). Based on this previous literature, we can show that parts of the association between the traits of openness-to-experience and neuroticism and expenditure behaviors is likely to be mediated by the relationships between these personality dimensions and the socio-economic characteristics of health, income and educational attainment. No such mediating effects are found for the traits of extraversion, agreeableness and conscientiousness. Clearly, this analysis is preliminary. Particularly, as we do not investigate the causal mechanisms underlying these relationships. A causal analysis of these relationships, for example, by means of a comprehensive structural equation model would therefore be an interesting complement to the current results.

Our analysis suffers from a number of shortcomings. In particular, we have to rely on preference measures that are derived from observed behavioral regularities and are therefore subject to measurement error. Thus, despite our efforts to control for these effects, correlations between preferences and expenditures, as well as between preferences and personality dimensions may be underestimating the true associations. Moreover, data availability rather than theory determines the expenditure categories used in this analysis, such that it remains unclear in how far our findings extend to other demand items or economically relevant behaviors like the adverse selection puzzle in the demand for life insurance coverage (Cawley and Philipson 1999; Caplan 2003). Also, since personality scores are only assessed for a single wave of the BHPS, assessing the robustness to individual-specific time-invariant effects has to rely on the empirically refuted assumption that personality scores are invariant over longer time horizons (Caspi et al. 2005; Almlund et al. 2011). While results from such tests, applying Hausman-Taylor estimators, do not differ substantially from the ones presented in this paper, applying fixed-effects estimators to other

panel data sets surveying respondent's personality score more often would likely provide interesting complementary insights.

Nevertheless, we are confident that our results point to a number of stylized facts on which future research could focus on. Above all, our results suggest that there are empirically significant and substantively non-negligible effects of personality dimensions on expenditure behavior. These effects are overwhelmingly direct, i.e. they neither reflect the influence of an omitted preference measure, nor do we find substantial mediating effects. In this sense, our results provide empirical support for the integration of personality dimensions as a further constraint into the understanding of economic behavior.

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## Tables and Figures

Table 1. Descriptive statistics for independents

| Subsample Variables             | Male   |        |     |        | Female |        |     |        |
|---------------------------------|--------|--------|-----|--------|--------|--------|-----|--------|
|                                 | Mean   | SD     | Min | Max    | Mean   | SD     | Min | Max    |
| <i>Indicators of interest</i>   |        |        |     |        |        |        |     |        |
| Openness                        | 4.485  | 1.195  | 1   | 7      | 4.318  | 1.249  | 1   | 7      |
| Conscientiousness               | 5.290  | 1.223  | 1   | 7      | 5.340  | 1.301  | 1   | 7      |
| Extraversion                    | 4.461  | 1.388  | 1   | 7      | 4.765  | 1.433  | 1   | 7      |
| Agreeableness                   | 5.076  | 1.204  | 1   | 7      | 5.385  | 1.200  | 1   | 7      |
| Neuroticism                     | 3.670  | 0.899  | 1   | 7      | 4.041  | 0.947  | 1   | 7      |
| <i>Further controls</i>         |        |        |     |        |        |        |     |        |
| Monthly household income (in £) | 2,487  | 1,503  | 236 | 17,424 | 2,274  | 1,367  | 168 | 15,357 |
| Age                             | 50.601 | 16.105 | 17  | 98     | 49.445 | 16.649 | 17  | 99     |
| Health                          | 3.847  | 0.899  | 1   | 5      | 3.747  | 0.947  | 1   | 5      |
| Education                       | 6.992  | 3.429  | 1   | 13     | 6.554  | 3.374  | 1   | 13     |
| Number of dependent children    | 0.589  | 0.969  | 0   | 7      | 0.646  | 0.996  | 0   | 7      |
| Weekly working hours            | 21.170 | 20.178 | 0   | 93     | 14.663 | 16.363 | 0   | 93     |
| Non white                       | 0.021  | 0.145  | 0   | 1      | 0.018  | 0.133  | 0   | 1      |
| Smoker                          | 0.232  | 0.422  | 0   | 1      | 0.240  | 0.427  | 0   | 1      |
| Household type                  | 3.445  | 1.356  | 1   | 9      | 3.693  | 1.499  | 1   | 9      |

N= 5,969 (female); 4,704 (male)

Table 2. Descriptive statistics for preference measures

| Subsample              | Male   |       |        |       |       | Female  |       |        |       |       |
|------------------------|--------|-------|--------|-------|-------|---------|-------|--------|-------|-------|
|                        | Mean   | SD    | Min    | Max   | Obs.  | Mean    | SD    | Min    | Max   | Obs.  |
| Preference for         |        |       |        |       |       |         |       |        |       |       |
| Leisure                | 0.0031 | 0.124 | -0.321 | 0.482 | 4,684 | -0.0000 | 0.109 | -0.287 | 0.502 | 5,964 |
| Food away<br>from home | 0.0017 | 0.159 | -0.588 | 0.493 | 4,704 | 0.0021  | 0.150 | -0.550 | 0.595 | 5,969 |

Table 3. Expenditure estimates for leisure activities

| Variables                         | Males OLS |           | Males INTREG |           | Females OLS |           | Females INTREG |           |
|-----------------------------------|-----------|-----------|--------------|-----------|-------------|-----------|----------------|-----------|
|                                   | (1)       | (2)       | (3)          | (4)       | (5)         | (6)       | (7)            | (8)       |
| Openness                          | 1.266*    | 1.205*    | 1.261*       | 1.203*    | 2.175***    | 1.998***  | 2.096***       | 1.927***  |
|                                   | (0.705)   | (0.705)   | (0.675)      | (0.672)   | (0.420)     | (0.423)   | (0.397)        | (0.398)   |
| Conscientiousness                 | -0.801    | -0.861    | -0.779       | -0.838    | -1.138***   | -1.169*** | -1.108***      | -1.136*** |
|                                   | (0.681)   | (0.686)   | (0.651)      | (0.652)   | (0.413)     | (0.413)   | (0.389)        | (0.389)   |
| Extraversion                      | 5.099***  | 5.057***  | 4.939***     | 4.901***  | 2.297***    | 2.289***  | 2.232***       | 2.222***  |
|                                   | (0.584)   | (0.585)   | (0.558)      | (0.556)   | (0.375)     | (0.372)   | (0.351)        | (0.348)   |
| Agreeableness                     | -2.934*** | -2.852*** | -2.847***    | -2.762*** | -0.606      | -0.567    | -0.561         | -0.522    |
|                                   | (0.704)   | (0.706)   | (0.674)      | (0.672)   | (0.424)     | (0.426)   | (0.401)        | (0.400)   |
| Neuroticism                       | -1.083    | -1.224    | -1.062       | -1.201    | -1.417***   | -1.492*** | -1.321***      | -1.393*** |
|                                   | (0.802)   | (0.804)   | (0.768)      | (0.767)   | (0.494)     | (0.495)   | (0.467)        | (0.466)   |
| Soc.-dem. controls                | Yes       | Yes       | Yes          | Yes       | Yes         | Yes       | Yes            | Yes       |
| Fixed effects<br>(month & region) | No        | Yes       | No           | Yes       | No          | Yes       | No             | Yes       |
| Observations                      | 4,684     | 4,684     | 4,684        | 4,684     | 5,964       | 5,964     | 5,964          | 5,964     |
| R-squared                         | 0.153     | 0.169     |              |           | 0.155       | 0.169     |                |           |
| Log Lik                           | -24780    | -24736    | -14128       | -14083    | -29717      | -29667    | -18197         | -18147    |

All estimations contain a constant. Robust standard errors in parentheses.

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

Table 4. Expenditure estimates for food away from home

| Variables                         | Males OLS            |                      | Males INTREG         |                      | Females OLS          |                      | Females INTREG       |                      |
|-----------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                   | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  |
| Openness                          | 0.994<br>(0.688)     | 1.156*<br>(0.692)    | 0.944<br>(0.662)     | 1.103*<br>(0.663)    | 0.367<br>(0.418)     | 0.392<br>(0.422)     | 0.315<br>(0.402)     | 0.350<br>(0.403)     |
| Conscientiousness                 | 0.942<br>(0.637)     | 0.869<br>(0.637)     | 0.960<br>(0.613)     | 0.885<br>(0.610)     | -0.320<br>(0.404)    | -0.377<br>(0.404)    | -0.284<br>(0.386)    | -0.339<br>(0.385)    |
| Extraversion                      | 3.235***<br>(0.571)  | 3.324***<br>(0.574)  | 3.091***<br>(0.549)  | 3.177***<br>(0.549)  | 2.600***<br>(0.366)  | 2.605***<br>(0.365)  | 2.525***<br>(0.350)  | 2.528***<br>(0.348)  |
| Agreeableness                     | -2.149***<br>(0.668) | -2.315***<br>(0.674) | -2.064***<br>(0.644) | -2.218***<br>(0.646) | -0.547<br>(0.432)    | -0.569<br>(0.435)    | -0.533<br>(0.413)    | -0.558<br>(0.414)    |
| Neuroticism                       | -0.943<br>(0.773)    | -1.012<br>(0.774)    | -0.873<br>(0.743)    | -0.941<br>(0.740)    | -1.656***<br>(0.503) | -1.816***<br>(0.504) | -1.589***<br>(0.478) | -1.745***<br>(0.477) |
| Soc.-dem. controls                | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Fixed effects<br>(month & region) | No                   | Yes                  | No                   | Yes                  | No                   | Yes                  | No                   | Yes                  |
| Observations                      | 4,704                | 4,704                | 4,704                | 4,704                | 5,969                | 5,969                | 5,969                | 5,969                |
| R-squared                         | 0.177                | 0.192                |                      |                      | 0.189                | 0.207                |                      |                      |
| Log Lik                           | -24716               | -24672               | -13549               | -13504               | -29822               | -29755               | -17393               | -17326               |

All estimations contain a constant. Robust standard errors in parentheses.

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

Table 5. Raw correlations between personality traits and preference measures

|                   | Male               |                     | Female             |                     |
|-------------------|--------------------|---------------------|--------------------|---------------------|
|                   | Preference for     |                     | Preference for     |                     |
|                   | Leisure activities | Food away from home | Leisure activities | Food away from home |
| Openness          | 0.1385***          | 0.0451***           | 0.1973***          | 0.0835*             |
| Conscientiousness | 0.0114             | 0.0057              | 0.0581***          | 0.0219*             |
| Extraversion      | 0.1118***          | 0.1602***           | 0.1078***          | 0.1424***           |
| Agreeableness     | 0.0422***          | 0.0034              | 0.0071             | 0.0213*             |
| Neuroticism       | 0.0019             | -0.0202             | -0.0799***         | -0.0541             |
| Observations      | 4,684              | 4,704               | 5,964              | 5,969               |

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

Table 6. OLS estimates including and excluding preference measures

|                   | Males                |                      |           |                      |                      |           | Females              |                      |           |                      |                      |          |
|-------------------|----------------------|----------------------|-----------|----------------------|----------------------|-----------|----------------------|----------------------|-----------|----------------------|----------------------|----------|
|                   | Leisure              |                      |           | Food away from home  |                      |           | Leisure              |                      |           | Food away from home  |                      |          |
|                   | Excluding preference | Including preference | $\Delta$  | Excluding preference | Including preference | $\Delta$  | Excluding preference | Including preference | $\Delta$  | Excluding preference | Including preference | $\Delta$ |
| Openness          | 1.205*               | 0.742                | 0.463***  | 1.156*               | 1.308**              | -0.152*** | 1.998***             | 1.430***             | 0.568***  | 0.392                | 0.160                | 0.232*** |
|                   | (0.705)              | (0.694)              | [11.90]   | (0.692)              | (0.662)              | [11.53]   | (0.423)              | (0.420)              | [45.86]   | (0.422)              | (0.410)              | [43.63]  |
| Conscientiousness | -0.861               | -0.164               | -0.697*** | 0.869                | 1.411**              | -0.542*** | -1.169***            | -1.075***            | -0.094    | -0.377               | -0.082               | -0.295   |
|                   | (0.686)              | (0.672)              | [27.19]   | (0.637)              | (0.618)              | [25.63]   | (0.413)              | (0.409)              | [1.94]    | (0.404)              | (0.396)              | [1.99]   |
| Extraversion      | 5.057***             | 4.242***             | 0.815***  | 3.324***             | 1.377**              | 1.947***  | 2.289***             | 1.988***             | 0.301***  | 2.605***             | 1.807***             | 0.798*** |
|                   | (0.585)              | (0.578)              | [44.68]   | (0.574)              | (0.562)              | [41.12]   | (0.372)              | (0.368)              | [21.87]   | (0.365)              | (0.355)              | [21.45]  |
| Agreeableness     | -2.852***            | -2.896***            | 0.044     | -2.315***            | -1.827***            | -0.488    | -0.567               | -0.427               | -0.14**   | -0.569               | -0.509               | -0.059** |
|                   | (0.706)              | (0.691)              | [0.14]    | (0.674)              | (0.638)              | [0.10]    | (0.426)              | (0.420)              | [3.96]    | (0.435)              | (0.424)              | [3.90]   |
| Neuroticism       | -1.224               | -1.330*              | 0.106     | -1.012               | -1.134               | 0.122     | -1.492***            | -1.223**             | -0.269*** | -1.816***            | -1.436***            | -0.38*** |
|                   | (0.804)              | (0.789)              | [0.50]    | (0.774)              | (0.739)              | [0.69]    | (0.495)              | (0.488)              | [10.86]   | (0.504)              | (0.494)              | [10.68]  |
| Preference proxy  | -                    | 74.979***            |           | -                    | 87.049***            |           | -                    | 54.635***            |           | -                    | 53.666***            |          |
|                   |                      | (6.001)              |           |                      | (3.978)              |           |                      | (4.966)              |           |                      | (2.920)              |          |
| Observations      | 4,684                | 4,684                |           | 4,704                | 4,704                |           | 5,964                | 5,964                |           | 5,969                | 5,969                |          |
| R-squared         | 0.169                | 0.196                |           | 0.192                | 0.259                |           | 0.169                | 0.189                |           | 0.207                | 0.245                |          |
| Log Lik           | -24736               | -24659               |           | -24672               | -24468               |           | -29667               | -29595               |           | -29755               | -29608               |          |

Note that  $\Delta = \beta_{\text{excluding preference proxy}} - \beta_{\text{including preference proxy}}$ . All estimations control for the respondent's equivalized household income (logged), age, age-squared, level of self-assessed health, average weekly working hours, and the number of dependent children living in the household. Additional dummy sets specify her level of educational attainment, household type, race, and whether she is a smoker. Finally, controls include a set of 47 region-month dummies. All estimations contain a constant. Robust standard errors in rounded parentheses. Chi2 values with one degree of freedom in squared brackets. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1



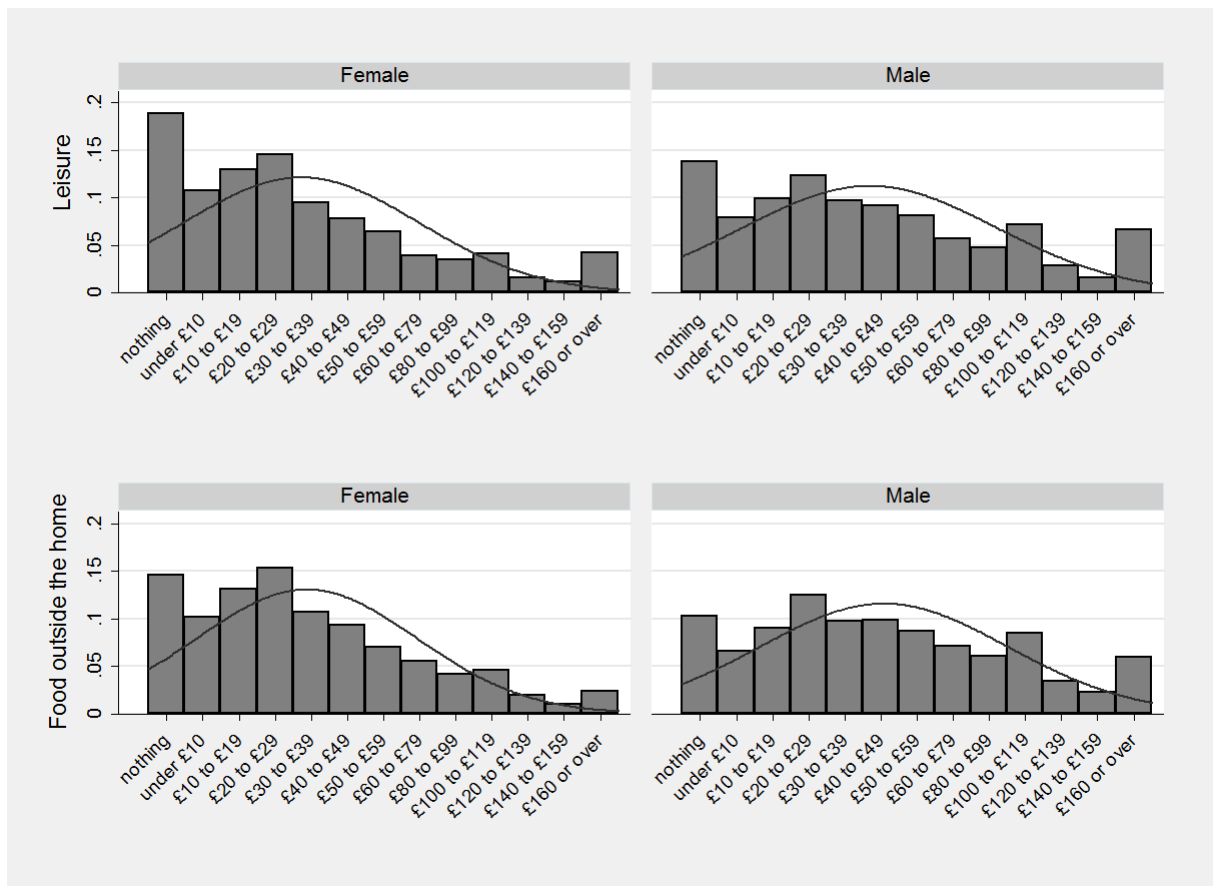
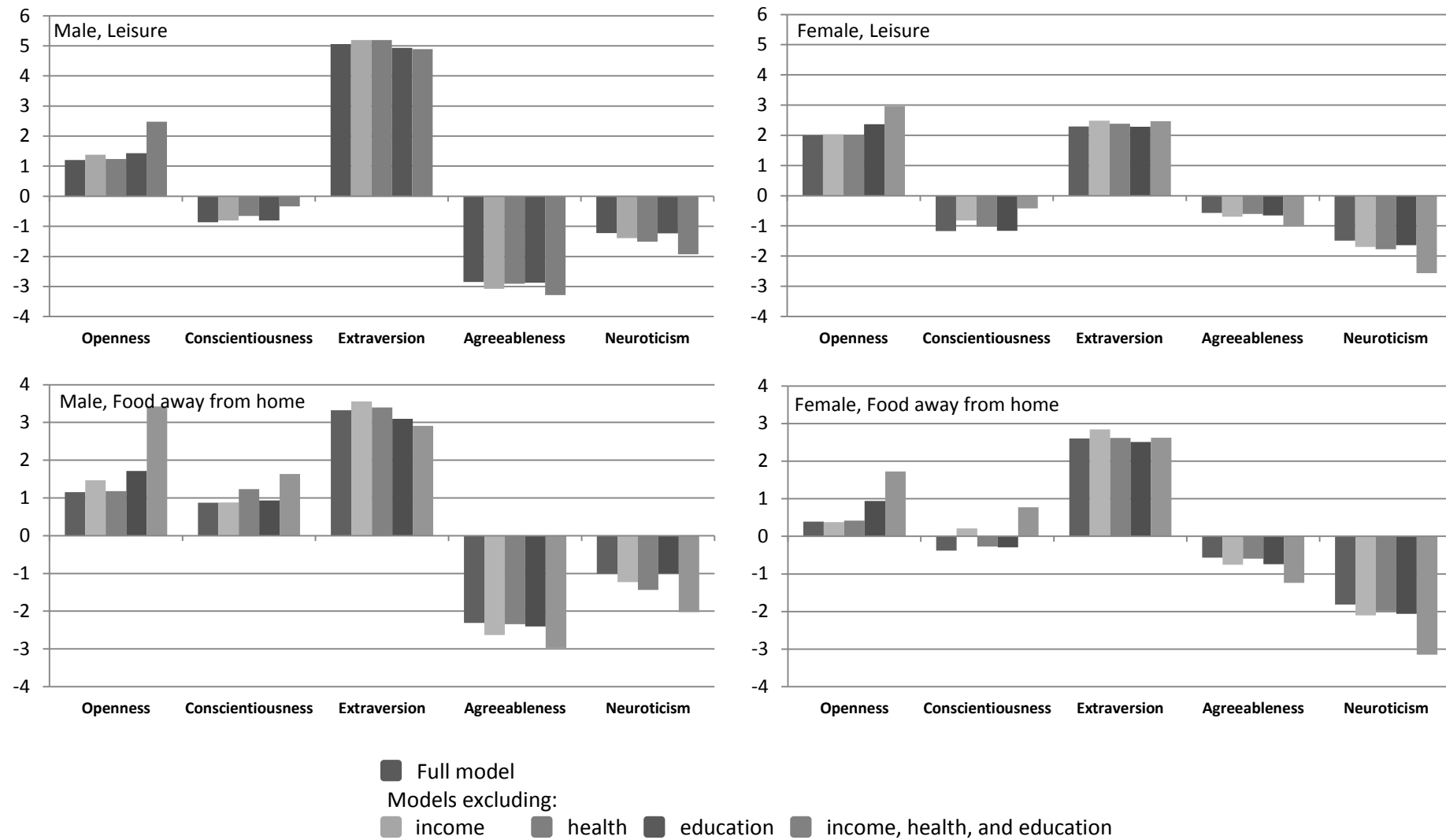


Figure 1. Histograms for expenditure categories in male and female subsamples (overlaid with Gaussian density fitted to the empirical mean and standard deviation of each subsample)

Figure 2: Coefficient size of big five personality measures conditional on control variables



## Appendix A

Table A1. Descriptive statistics for dependents

| Subsample           | Male              |       |     |     |                 | Female            |       |     |     |                 |
|---------------------|-------------------|-------|-----|-----|-----------------|-------------------|-------|-----|-----|-----------------|
|                     | Mean of midpoints | SD    | Min | Max | Median category | Mean of midpoints | SD    | Min | Max | Median category |
| Leisure             | 51.43             | 52.18 | 0   | 190 | £30 to £39      | 31.18             | 38.40 | 0   | 190 | £20 to £29      |
| Food away from home | 56.11             | 50.98 | 0   | 190 | £40 to £49      | 37.24             | 39.74 | 0   | 190 | £20 to £29      |

$N_{\text{Leisure}} = 5,964$  (female); 4,684 (male)/  $N_{\text{Food away from home}} = 5,969$  (female); 4,704 (male); Both expenditures are coded in 13 categories: nothing (0); under £10 (1); £10 to under £20 (2); £20 to under £30 (3); £30 to under £40 (4); £40 to under £50 (5); £50 to under £60 (6); £60 to under £80 (7); £80 to under £100 (8); £100 to under £120 (9); £120 to under £140 (10); £140 to under £160 (11) and £160 or more. Values refer to average monthly expenditures over the past year.

Table A2. Coding of socio-economic controls

| Variable                              | Male<br>Mean (SD)  | Female<br>Mean (SD) | Coding   |
|---------------------------------------|--------------------|---------------------|--|
| <b>Continuous measures</b>            |                    |                     |  |
| Household income                      | 7.656<br>(0.581)   | 7.567<br>(0.578)    | Logged Household income per equivalent adult in month prior to interview   |
| Age                                   | 50.601<br>(16.105) | 49.445<br>(16.649)  | Age in years   |
| Weekly working hours                  | 21.17<br>(20.18)   | 14.663<br>(16.363)  | Average weekly working hours in the past 12 months   |
| Self-assessed health                  | 3.847<br>(0.899)   | 3.747<br>(0.947)    | Self-reported health status over past 12 months: 5 if excellent, 4 if good, 3 if fair, 2 if poor, 1 if very poor |
| Number of children                    | 0.589<br>(0.969)   | 0.646<br>(0.996)    | Number of children under 16 living in respondent's household   |
| <b>Dummy sets</b>                     |                    |                     |  |
| Race                                  | 0.021<br>(0.145)   | 0.018<br>(0.133)    | 1 if non-white; zero otherwise   |
| Smoking behavior                      | 0.232<br>(0.422)   | 0.240<br>(0.427)    | 1 if currently a smoker; zero otherwise  |
| <b>Highest educational attainment</b> |                    |                     |  |
| Sill at school                        | 0.010<br>(0.100)   | 0.013<br>(0.115)    | 1 if highest educational attainment, zero otherwise  |
| No formal qualification               | 0.213<br>(0.410)   | 0.256<br>(0.437)    | 1 if highest educational attainment, zero otherwise  |
| Other qualification                   | 0.008<br>(0.091)   | 0.009<br>(0.096)    | 1 if highest educational attainment, zero otherwise  |
| Apprenticeship                        | 0.047<br>(0.213)   | 0.006<br>(0.077)    | 1 if highest educational attainment, zero otherwise  |
| CSE grade 2-5, scot grade 4-5         | 0.041<br>(0.199)   | 0.038<br>(0.192)    | 1 if highest educational attainment, zero otherwise  |
| Commercial qualification, no O-levels | 0.003<br>(0.054)   | 0.053<br>(0.224)    | 1 if highest educational attainment, zero otherwise  |
| GCE O-levels or equivalent            | 0.213<br>(0.410)   | 0.259<br>(0.438)    | 1 if highest educational attainment, zero otherwise  |
| GCE A-levels                          | 0.142<br>(0.349)   | 0.103<br>(0.304)    | 1 if highest educational attainment, zero otherwise  |

|   |                  |                  |  |
|---|------------------|------------------|--|
| Nursing qualification                   | 0.002<br>(0.044) | 0.034<br>(0.181) | 1 if highest educational attainment, zero otherwise      |
| Other higher qualification              | 0.185<br>(0.388) | 0.096<br>(0.294) | 1 if highest educational attainment, zero otherwise      |
| Teaching qualification                  | 0.017<br>(0.130) | 0.035<br>(0.183) | 1 if highest educational attainment, zero otherwise      |
| First degree                            | 0.091<br>(0.287) | 0.082<br>(0.273) | 1 if highest educational attainment, zero otherwise      |
| Higher degree                           | 0.027<br>(0.162) | 0.017<br>(0.128) | 1 if highest educational attainment, zero otherwise      |
| <b>Household Type</b>                   |                  |                  |  |
| Single non-elderly                      | 0.101<br>(0.301) | 0.060<br>(0.237) | 1 if household type of current residence, zero otherwise |
| Single elderly                          | 0.054<br>(0.226) | 0.114<br>(0.318) | 1 if household type of current residence, zero otherwise |
| Couple no children                      | 0.380<br>(0.486) | 0.315<br>(0.465) | 1 if household type of current residence, zero otherwise |
| Couple with dependent children          | 0.328<br>(0.469) | 0.296<br>(0.457) | 1 if household type of current residence, zero otherwise |
| Couple with non-dependent children      | 0.097<br>(0.296) | 0.089<br>(0.284) | 1 if household type of current residence, zero otherwise |
| Lone parent with dependent children     | 0.007<br>(0.085) | 0.078<br>(0.269) | 1 if household type of current residence, zero otherwise |
| Lone parent with non-dependent children | 0.012<br>(0.110) | 0.031<br>(0.174) | 1 if household type of current residence, zero otherwise |
| 2 or more unrelated adults              | 0.010<br>(0.099) | 0.007<br>(0.086) | 1 if household type of current residence, zero otherwise |
| Other households                        | 0.010<br>(0.098) | 0.009<br>(0.096) | 1 if household type of current residence, zero otherwise |

N= 5,969 (female); 4,704 (male)

Table A3: INTREG estimates including and excluding preference measures

| Variables         | Males     |           |                     |           | Females   |           |                     |           |
|-------------------|-----------|-----------|---------------------|-----------|-----------|-----------|---------------------|-----------|
|                   | Leisure   |           | Food away from home |           | Leisure   |           | Food away from home |           |
| Openness          | 1.203*    | 0.744     | 1.103*              | 1.256**   | 1.927***  | 1.372***  | 0.350               | 0.125     |
|                   | (0.672)   | (0.660)   | (0.663)             | (0.631)   | (0.398)   | (0.394)   | (0.403)             | (0.391)   |
| Conscientiousness | -0.838    | -0.156    | 0.885               | 1.415**   | -1.136*** | -1.044*** | -0.339              | -0.053    |
|                   | (0.652)   | (0.638)   | (0.610)             | (0.590)   | (0.389)   | (0.384)   | (0.385)             | (0.377)   |
| Extraversion      | 4.901***  | 4.094***  | 3.177***            | 1.267**   | 2.222***  | 1.928***  | 2.528***            | 1.754***  |
|                   | (0.556)   | (0.548)   | (0.549)             | (0.535)   | (0.348)   | (0.343)   | (0.348)             | (0.337)   |
| Agreeableness     | -2.762*** | -2.803*** | -2.218***           | -1.736*** | -0.522    | -0.386    | -0.558              | -0.498    |
|                   | (0.672)   | (0.656)   | (0.646)             | (0.610)   | (0.400)   | (0.395)   | (0.414)             | (0.403)   |
| Neuroticism       | -1.201    | -1.310*   | -0.941              | -1.065    | -1.393*** | -1.131**  | -1.745***           | -1.375*** |
|                   | (0.767)   | (0.751)   | (0.740)             | (0.705)   | (0.466)   | (0.459)   | (0.477)             | (0.468)   |
| Preference proxy  | -         | 74.003*** | -                   | 84.793*** | -         | 53.397*** | -                   | 52.082*** |
|                   |           | (5.726)   |                     | (3.814)   |           | (4.625)   |                     | (2.782)   |
| Observations      | 4,684     | 4,684     | 4,704               | 4,704     | 5,964     | 5,964     | 5,969               | 5,969     |
| Log Lik           | -14083    | -14002    | -13504              | -13295    | -18147    | -18069    | -17326              | -17174    |

All estimations control for the respondent's equivalized household income (logged), age, age-squared, level of self-assessed health, average weekly working hours, and the number of dependent children living in the household. Additional dummy sets specify her level of educational attainment, household type, race, and whether she is a smoker. Finally, controls include a set of 47 region-month dummies. All estimations contain a constant. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## Appendix B: Results from a direct estimation of indirect effects

The effect of individual  $i$ 's personality trait  $s$  on her expenditures for good  $g$  is the full derivative of expenditures with respect to this personality trait, accounting for the effects of personality through income, health, and education. This derivative is given by:

$$\begin{aligned}
 \frac{dc_i^g}{dp_i^s} = & \frac{\partial c_i^g}{\partial p_i^s} + \left( \frac{\partial c_i^g}{\partial \ln(\text{income})_i} \times \frac{\partial \ln(\text{income})_i}{\partial p_i^s} \right) + \left( \frac{\partial c_i^g}{\partial \text{Educ}_i} \times \frac{\partial \text{Educ}_i}{\partial p_i^s} \right) \\
 & + \left( \frac{\partial c_i^g}{\partial \text{Health}_i} \times \frac{\partial \text{Health}_i}{\partial p_i^s} \right) \\
 & + \left( \frac{\partial c_i^g}{\partial \ln(\text{income})_i} \times \frac{\partial \ln(\text{income})_i}{\partial \text{Educ}_i} \times \frac{\partial \text{Educ}_i}{\partial p_i^s} \right) \\
 & + \left( \frac{\partial c_i^g}{\partial \ln(\text{income})_i} \times \frac{\partial \ln(\text{income})_i}{\partial \text{Health}_i} \times \frac{\partial \text{Health}_i}{\partial p_i^s} \right) \\
 & + \left( \frac{\partial c_i^g}{\partial \ln(\text{income})_i} \times \frac{\partial \ln(\text{income})_i}{\partial \text{Health}_i} \times \frac{\partial \text{Health}_i}{\partial \text{Educ}_i} \times \frac{\partial \text{Educ}_i}{\partial p_i^s} \right)
 \end{aligned} \tag{B1}$$

The first right-hand side term specifies the direct effect of personality on expenditures, conditional on income, health, and educational attainment. The following three terms specify the effect of personality on expenditures through logged household income, education and subjective health, respectively. The fourth and fifth terms give the effect of personality on expenditures via the effects of education and health on income. The final sixth term then accounts for the effects of personality on expenditures which are mediated by the effects of income that can be assigned to education's impact on health.

As only the first term of equation (B1) can be estimated from model (1), the remaining terms are estimated using auxiliary models which predict (logged) equivalized household income, subjective health and educational attainment. In accordance with the previous literature assessing the relationship between personality and these three socio-demographics (see Heckman et al. 2006; Almlund et al. 2011; Heineck 2011), the following controls were employed in each estimation:

- Income: Age and age squared, education, health, tenure, live-in partner's income (0 if no partner). Further dummy sets specify race (0 – UK born, 1 – not UK born), smoking behavior (0 – non-smoker, 1 – smoker), self-employment (0 – No, 1 – Yes), unemployment (0 – No, 1 – Yes), retirement (0 – No, 1 – Yes), firm size (3 dummies), private-sector employer (0 – No, 1 – Yes), household type (8 dummies) and geographic location (11 dummies).
- Education: Age and age squared. Further dummy sets specify race (0 – UK born, 1 – not UK born), father unemployed when respondent was 15 (0 – No, 1 – Yes), mother

unemployed when respondent was 15 (0 – No, 1 – Yes), father’s highest educational attainment (5 dummies), mother’s father’s highest educational attainment (5 dummies).

- Health: Age and age squared, education, number of dependent children, household size. Further dummy sets specify race (0 – UK born, 1 – not UK born), widowed (0 – No, 1 – Yes), divorced or separated (0 – No, 1 – Yes), self-employment (0 – No, 1 – Yes), unemployment (0 – No, 1 – Yes), father unemployed when respondent was 15 (0 – No, 1 – Yes) , mother unemployed when respondent was 15 (0 – No, 1 – Yes), father’s highest educational attainment (5 dummies), mother’s father’s highest educational attainment (5 dummies), household type (8 dummies).

All variables are standardized prior to estimations. Marginal effects are estimated applying OLS estimators, and standard errors are obtained by bootstrapping. Results for the full derivative (left hand side term of equation (B1)) and the direct effect (first right hand side term) are given in Table B1. Note that the slight differences in statistical significance compared to the results from Tables 3. and 4. are due to differences in sample size. These differences are the result of non-response to some of the additional variables used in the estimations on health, income and education.

Table B1: Direct and indirect effects of personality on expenditure behavior. Product of coefficients approach.

|  | Leisure              |                      | Food outside the home |                      |
|--|----------------------|----------------------|-----------------------|----------------------|
|  | Male                 | Female               | Male                  | Female               |
| Direct effect: $\partial c_i^g / \partial p_i^s$ |                      |                      |                       |                      |
| Openness   | 0.031*<br>(0.019)    | 0.044***<br>(0.011)  | 0.030<br>(0.019)      | 0.002<br>(0.012)     |
| Conscientiousness                                | -0.020<br>(0.018)    | -0.035***<br>(0.011) | 0.022<br>(0.018)      | -0.010<br>(0.011)    |
| Extraversion                                     | 0.140***<br>(0.018)  | 0.074***<br>(0.011)  | 0.105***<br>(0.018)   | 0.088***<br>(0.012)  |
| Agreeableness                                    | -0.070***<br>(0.018) | -0.012<br>(0.011)    | -0.057***<br>(0.018)  | -0.015<br>(0.012)    |
| Neuroticism                                      | -0.025<br>(0.016)    | -0.027***<br>(0.010) | -0.020<br>(0.016)     | -0.027**<br>(0.011)  |
| Full derivative: $dc_i^g / dp_i^s$               |                      |                      |                       |                      |
| Openness   | 0.047***<br>(0.016)  | 0.087***<br>(0.015)  | 0.064***<br>(0.015)   | 0.040***<br>(0.014)  |
| Conscientiousness                                | -0.011<br>(0.016)    | -0.033**<br>(0.016)  | 0.032**<br>(0.016)    | 0.001<br>(0.015)     |
| Extraversion                                     | 0.124***<br>(0.015)  | 0.094***<br>(0.014)  | 0.085***<br>(0.016)   | 0.100***<br>(0.015)  |
| Agreeableness                                    | -0.072***<br>(0.018) | -0.027*<br>(0.014)   | -0.064***<br>(0.018)  | -0.031**<br>(0.015)  |
| Neuroticism                                      | -0.029*<br>(0.015)   | -0.057***<br>(0.013) | -0.029*<br>(0.015)    | -0.055***<br>(0.013) |
| Observations                                     | 4,351                | 5,263                | 4,371                 | 5,267                |

All estimations contain a constant. Bootstrapped standard errors in parentheses.

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