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**Working Paper**

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School of Economics Discussion Papers, No. 2205

**Provided in Cooperation with:**
University of Kent, School of Economics

*Suggested Citation:* Cherodian, Rowan; Gschwandtner, Adelina; Jewell, Sarah L.; Kambhampati, Uma S. (2022) : Neuroticism and sport: How personality affects lifestyle in the UK, School of Economics Discussion Papers, No. 2205, University of Kent, School of Economics, Canterbury

This Version is available at:
https://hdl.handle.net/10419/284196

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# Neuroticism and Sport: How Personality affects Lifestyle in the UK

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December 2022

KDPE 2205

**Neuroticism and Sport: How Personality affects Lifestyle in the UK**

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## Abstract

In recent years, researchers have become increasingly aware of the impact that personality traits have on individual lifestyle decisions, both positive and negative. Using longitudinal data from a large household survey as well as genetic information from the UK, the present study unveils the causal relationship between neuroticism as a personality trait and sports activity. Our results suggest that neuroticism leads individuals to perform less sports activities. While this result is intuitive, our method establishes causality and draws attention to the difficulty of policy in this area. In particular, one of the main ways recommended to help improve neuroticism is exercise but our results indicate that neurotic individuals are less likely to take up sporting activity. In this context, tailoring lifestyle recommendations to personality would significantly improve their results and help increase the efficacy of health policy. This is important to reduce the economic burden of ill health.

**Keywords:** Big5 Personality Traits, Neuroticism, Exercise, Lifestyle, Personalized Medical Care
**JEL Classifications:** I12, I14, I31, C18, D91, Z20

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## I. Introduction

There is considerable theoretical and empirical evidence that specific personality traits are associated with either engagement or abstinence in certain health behaviours that ultimately impact on health outcomes (Friedman 2000, Smith, 2006, Israel et al 2014). Lifestyle has long been known to influence individual well-being (Grant et al 2009, Blanchflower et al 2013, Mujcic and Oswald 2016, Ocean et al 2019, Gschwandtner et al 2021). We also know from the literature that personality influences wellbeing (De Neve and Cooper 1998, Hayes and Joseph 2003, Kwon 2021) and a much smaller literature has spoken of how personality influences lifestyle (Bogg and Roberts 2004, Lodi-Smith et al 2010, Cobb-Clarke et al 2014). In this paper, we add to this literature by establishing causality using gene data which is exogenous and therefore a better instrument than any that has so far been used in the economics literature on this issue. We consider the causal impact that a particular personality trait – neuroticism - has on the level of activity undertaken by individuals.

Empirical evidence in the literature has shown that lower levels of conscientiousness and higher levels of neuroticism are linked to negative health behaviours, such as smoking tobacco, excessive alcohol use, illicit drug use, and unhealthy eating habits (Bogg & Roberts, 2004; Hopwood et al., 2007; Kashdan, Vetter, and Collins, 2005; Malouff, Thorsteinsson, and Schutte, 2006; Mroczek et al., 2009; Munafò, Zetteler, and Clark, 2007; Terracciano et al., 2008). Not surprisingly therefore, there is evidence that both mortality and morbidity are influenced by personality through health behaviour mechanisms (Lodi-Smith et al 2010, Hagger-Johnson et al 2012, Turiano et al 2015). The health behaviour model of personality suggests a chain of causality from personality to health behaviour and from there to health outcomes (Smith, 2006, Fig 1, page 229). Personality, for example, can determine how health behaviours are changed because of stress and how the individual is coping (or not) with stressful circumstances. The effect of personality and accumulated health behaviours has been shown to affect health assessed more than 40 years later (Hampson, Edmonds, Goldberg, Dubanoski, & Hillier, 2015).

In this article, we extend this evidence by determining the causal impact that neuroticism has on an important health behaviour: sports activity. This is especially important in the case of this personality

trait as regular exercise is one of the main recommendations for improving the health conditions associated with it that significantly contribute to the economic burden of ill health (Scarborough et al 2011). One of the problems with analyses of this kind is that measurement error and missing variables make it difficult to identify the causal impact of personality on health behaviours. Our contribution is especially important as even though there is ample empirical evidence about the negative association between neuroticism and sport, we are not aware of any study showing causality.

## II. Data

We make use of the UK Understanding Society Data – Household Longitudinal Study (UKHLS) - to estimate our models empirically. The survey follows a sample of 40,000 UK households over time and began in 2009 as a successor to the UK BHPS longitudinal survey. To capture personality traits, we selected single nucleotide polymorphisms (SNPs) associated with them, using the catalogue of genome-wide association studies (GWAS) (https://www.ebi.ac.uk/gwas/) and by conducting a literature search (Smith et al., 2016; Lo et al., 2015; Amin et al., 2013; Bae et al., 2013; De Moor et al., 2012; Luciano et al., 2012; Verweij et al., 2010; Terraciano et al., 2010; Calboli et al., 2010). A list with the SNPs used for personality traits, can be found in the Appendix. Data was obtained via application from METADAC UK (https://www.metadac.ac.uk/). We have a dummy for each SNP associated with each of an individual's personality traits and this helps to capture the signal of this genetic information. Several studies have found an association between this genetic information and personality traits such as Neuroticism (de Moor et al. 2012) and they therefore provide plausible instruments for personality.

We use a sample of individuals who fully respond (provide a full interview and self-completion form) in wave 5 and provide answers to all the questions we make use of. This gives us a sample of 5,257 observations in total. Questions about exercise were asked in waves 2 and 5. and the personality questions were asked in wave 3. We therefore make use of wave 5 for our main analysis in this paper.

The dataset includes two questions relating to exercise. The first asks individuals 'On a scale of 0 to 10, with 0 being 'doing no sport at all' to 10 being 'very active through sport', where would you rank yourself?'. We call this the *Sports Activity* variable. The second asks the frequency of doing moderate and mild sports. This question provides us with two further activity variables - *Moderate Sport* and *Mild*

*Sport* – which are dummy variables indicating if an individual does moderate/mild sport at least once a week. Neuroticism is captured by a sum of responses to three questions - I see myself as someone who worries a lot, I see myself as someone who gets nervously easily, I see myself as someone who is relaxed, handles stress well. These are all answered on a scale of 1 (does not apply to me) to 7 (applies to me perfectly). We reverse code the response to the last question.

## III. Methodology

To determine if neuroticism has a causal impact on sports activity, we estimate the following system of equations:

$$sport_i = \beta_0 + \beta_1 neuro_i + \gamma X_i + \varepsilon_i$$

$$neuro_i = \alpha_0 + \delta H_i + \gamma X_i + \varepsilon_i$$

where $sport_i$ is measured in three ways - *Sports Activity*, *Moderate Sport*, and *Mild Sport.* $X_i$ is a vector of controls including, gender, age, country, equivalized household income, education, marital status, long-term health condition, employment status, and number of young children, $H_i$ is an instrument vector with 31 genes that are known to be associated with personality traits.[1] Since the association between the gene instruments and the personality trait (neuroticism) is weak,[2] we cannot use a classical Instrumental Variable Method as the estimates would be biased. Instead, we estimate the system using a continuously updating estimator (CUE) with Newey and Windmeijer (2009) corrected standard errors as this estimator is unbiased when there are many weak instruments and is also robust to conditional heteroskedasticity (Davis et al., 2014).[3] Table 3 in the Appendix presents first stage results for the association between the instruments and neuroticism.

[1] See the Appendix for list of Single Nucleotide Polymorphisms (SNPs) used as instruments.
[2] The association between genes and personality attributes is often weak.
[3] If instruments are weak, two-stage least squares (2SLS) is biased, whereas both the limited information maximum likelihood (LIML) and the continuously updating estimator (CUE) are unbiased. We use CUE as unlike LIML it is robust to conditional heteroskedasticity (Davis et al., 2014).

## IV. Main Results

### Table 1. Descriptive Statistics

| Variable | Mean | St Dev | Min | Max |
|---|---|---|---|---|
| Sport Activity | 3.62 | 2.89 | 0 | 10 |
| Moderate Sport | 0.39 | 0.49 | 0 | 1 |
| Mild Sport | 0.25 | 0.43 | 0 | 1 |
| Neuroticism | 3.65 | 1.44 | -9 | 7 |
| Female | 0.58 | 0.50 | 0 | 1 |
| Age 36-50 | 0.40 | 0.49 | 0 | 1 |
| Age 51 + | 0.41 | 0.49 | 0 | 1 |
| North | 0.43 | 0.50 | 0 | 1 |
| South | 0.39 | 0.49 | 0 | 1 |
| Married | 0.57 | 0.49 | 0 | 1 |
| Higher Degree | 0.42 | 0.49 | 0 | 1 |
| Child Age 0-2 | 0.06 | 0.24 | 0 | 1 |
| Child Age 3-4 | 0.06 | 0.23 | 0 | 1 |
| Child Age 5-11 | 0.15 | 0.36 | 0 | 1 |
| Child Age 12-15 | 0.08 | 0.27 | 0 | 1 |
| Employed | 0.76 | 0.43 | 0 | 1 |
| Unemployed | 0.04 | 0.19 | 0 | 1 |
| Inc. 2nd Quartile | 0.24 | 0.42 | 0 | 1 |
| Inc. 3rd Quartile | 0.26 | 0.44 | 0 | 1 |
| Inc. 4th Quartile | 0.26 | 0.44 | 0 | 1 |
| Illness Long | 0.31 | 0.46 | 0 | 1 |
| Urban | 0.73 | 0.44 | 0 | 1 |

### Table 2. Main Results

| Variable | Sports Activity Ranking | | Mild sport 1+ times per week | | Moderate Sport 1+ times per week | |
|---|---|---|---|---|---|---|
| | OLS | IV | OLS | IV | OLS | IV |
| **Neuroticism** | -0.193*** | -0.451* | -0.00924** | -0.0115 | -0.0193*** | -0.0909** |
| | (0.0269) | (0.248) | (0.00428) | (0.0384) | (0.00465) | (0.0438) |
| **Female** | -0.510*** | -0.376** | 0.0529*** | 0.0536** | -0.0512*** | -0.0150 |
| | (0.0786) | (0.152) | (0.0124) | (0.0235) | (0.0137) | (0.0269) |
| **Age Group (ref: 18-35)** | | | | | | |
| 36-50 | -0.793*** | -0.848*** | 0.0579*** | 0.0576*** | -0.0527*** | -0.0658*** |
| | (0.111) | (0.123) | (0.0165) | (0.0176) | (0.0200) | (0.0221) |
| 51+ | -1.381*** | -1.488*** | 0.0582*** | 0.0576** | -0.126*** | -0.156*** |
| | (0.119) | (0.158) | (0.0185) | (0.0242) | (0.0212) | (0.0285) |
| **Region (ref: Wales)** | | | | | | |
| North | 0.242 | 0.269* | -0.0129 | -0.0141 | 0.000319 | 0.00614 |
| | (0.150) | (0.157) | (0.0238) | (0.0241) | (0.0257) | (0.0269) |
| South | 0.282* | 0.300* | 0.00480 | 0.00304 | 0.0328 | 0.0383 |
| | (0.152) | (0.157) | (0.0242) | (0.0244) | (0.0262) | (0.0273) |
| Scotland | 0.258 | 0.304 | -0.0151 | -0.0180 | -0.00595 | 0.00586 |
| | (0.179) | (0.188) | (0.0288) | (0.0300) | (0.0314) | (0.0331) |
| Married | -0.161* | -0.164* | 0.0141 | 0.0128 | -0.0245* | -0.0251* |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (0.0827) | (0.0841) | (0.0134) | (0.0135) | (0.0145) | (0.0150) |
| Degree | 0.715*** | 0.709*** | 0.0316** | 0.0325** | 0.123*** | 0.122*** |
| | (0.0802) | (0.0821) | (0.0129) | (0.0132) | (0.0143) | (0.0149) |
| **Age of the Youngest Child (ref: no children under 16)** | | | | | | |
| Aged 0-2 | -0.531*** | -0.599*** | -0.0945*** | -0.0949*** | -0.0269 | -0.0425 |
| | (0.172) | (0.189) | (0.0239) | (0.0255) | (0.0306) | (0.0329) |
| Aged 3-4 | -0.0717 | -0.0275 | -0.0926*** | -0.0885*** | 0.0395 | 0.0439 |
| | (0.172) | (0.174) | (0.0250) | (0.0250) | (0.0316) | (0.0325) |
| Aged 5-11 | 0.458*** | 0.460*** | -0.0540*** | -0.0535*** | 0.0666*** | 0.0653*** |
| | (0.120) | (0.122) | (0.0189) | (0.0192) | (0.0215) | (0.0222) |
| Aged 12-15 | 0.400*** | 0.363** | -0.00767 | -0.00838 | 0.0756*** | 0.0631** |
| | (0.153) | (0.163) | (0.0244) | (0.0259) | (0.0267) | (0.0287) |
| **Employment Status (ref: Inactive)** | | | | | | |
| Employed | 0.00756 | -0.0260 | -0.0461*** | -0.0455** | -0.0330* | -0.0462** |
| | (0.103) | (0.117) | (0.0169) | (0.0187) | (0.0177) | (0.0202) |
| Unemployed | 0.0380 | 0.0538 | 0.0111 | 0.0115 | 0.0277 | 0.0306 |
| | (0.203) | (0.208) | (0.0349) | (0.0354) | (0.0362) | (0.0375) |
| **Income Quartile (ref: 1st)** | | | | | | |
| 2nd | 0.268** | 0.233** | -0.00635 | -0.00682 | 0.0280 | 0.0215 |
| | (0.112) | (0.116) | (0.0174) | (0.0178) | (0.0188) | (0.0198) |
| 3rd | 0.596*** | 0.574*** | 0.0143 | 0.0147 | 0.0827*** | 0.0763*** |
| | (0.113) | (0.117) | (0.0181) | (0.0186) | (0.0195) | (0.0204) |
| 4th | 1.010*** | 0.966*** | -0.00149 | -0.00195 | 0.121*** | 0.112*** |
| | (0.121) | (0.128) | (0.0195) | (0.0204) | (0.0213) | (0.0227) |
| **Longstanding health problem** | -0.855*** | -0.768*** | -0.0425*** | -0.0411** | -0.105*** | -0.0798*** |
| | (0.0859) | (0.128) | (0.0138) | (0.0201) | (0.0148) | (0.0225) |
| **Urban area** | -0.0901 | -0.0599 | -0.0876*** | -0.0887*** | -0.00239 | 0.00686 |
| | (0.0863) | (0.0928) | (0.0144) | (0.0153) | (0.0150) | (0.0165) |
| Constant | 4.841*** | 5.755*** | 0.323*** | 0.331** | 0.499*** | 0.753*** |
| | (0.230) | (0.903) | (0.0360) | (0.140) | (0.0391) | (0.160) |
| | | | | | | |
| R-squared | 0.139 | 0.123 | 0.029 | 0.029 | 0.072 | 0.030 |
| Weak id F-statistic | - | 3.30 | - | 3.30 | - | 3.30 |
| Under id P-value | - | 0.00 | - | 0.00 | - | 0.00 |

*Note*: Robust standard errors and Newey and Windmeijer (2009) standard errors in parentheses for OLS and IV. *** p<0.01, ** p<0.05, * p<0.1. "Weak id F-statistic" is the Cragg-Donald Wald F statistic (a test for weak instruments) with Stock-Yogo weak ID test critical values of 3.89 and 2.19 for 10% and 15% maximal LIML size (assumes IID errors). "Under id P-value" is the P-value for a Kleibergen-Paap rk LM test with a null hypothesis of the reduced form matrix of coefficients is under-identified. The sample size is 5,256 in each regression.

The summary statistics in Table 1 indicate that individuals see themselves as relatively inactive with an average score of 3.62 on a scale of 0 - 10. We also see that levels of neuroticism are quite high, with an average score of 3.65 on a scale of 0-7. There are slightly more women than men in the sample and slightly more in the North than the South. A significant proportion are married, and a very high

proportion are urban and employed. There is a significant incidence of long-term illness in the sample with an average of 0.31 on a scale of 0-1.

Table 2 above provides the results for our estimation. We include a wide range of controls - gender, age, region, education, age of youngest child, employment status, marital status, income, and rural urban area. We also include a control for long standing health problems as these may affect how much activity an individual is able to do. We analyse the effect of neuroticism on three sports variables - *Sports Activity*, *Moderate Sport*, and *Mild Sport*.

Our results indicate that women generally see themselves as doing less *Sports Activity*. However, they do more *Mild Sport* per week than men do. Sports activity, however measured, decreases with age. There are no major regional differences in such activity, though individuals in the South see themselves as doing more. Married people seem to do less sports and degree holders do more. While having very young children decreases the probability of sports, having older children (over five years) increases the probability of *Moderate Sport* and *Sports Activity*. The employed do less sport and *Sports Activity* and *Moderate Sport* increase with income quantile. Interestingly, there is no income effect on *Mild Sport* at all. Those with long standing health problems do less sport and those living in urban areas do less *Mild Sport* though this doesn't affect *Sports Activity* and *Moderate Sport*.

Turning now to our main variable of interest, we find that more neurotic individuals are less likely to do *Sports Activity* with a one unit increase in neuroticism leading to 0.45 units decrease in sporting activity (on a scale of 1 to 10). While neuroticism doesn't significantly affect *Mild Sport*, it leads to a significant decrease in *Moderate Sport* of the order of -0.09 units for every unit increase in neuroticism. Various heterogeneity effects by gender, income, age, and educational status yield similar results.[4]

[4] Results can be obtained by the authors by request.

## VI. Concluding Remarks

Lifestyle has long been known to influence individual well-being. We also know from the literature that personality influences wellbeing and a much smaller literature has spoken of how personality influences lifestyle. In this paper, we consider the impact of personality traits on health behaviours that affect health outcomes. We add to the literature by establishing causality using gene data which is exogenous and therefore a better instrument than any that has so far been used in the economics literature on this issue. While the impact of health behaviours such as drinking and smoking on health outcomes such as cardiovascular diseases has been extensively documented, the relationship between personality and lifestyle decisions has not advanced, to our knowledge, beyond simple correlations. We contribute to the literature by showing that neuroticism *causes* a significant decrease in the degree of sports activity individuals undertake. In particular, we show that while it does not seem to affect mild sport activities significantly, it leads to a significant decrease in more moderate sport activities and in how active individuals perform sports overall. This finding is especially important in the case of this personality trait where regular exercise is one of the main recommendations for improving the health conditions associated with it. We show that individuals high in neuroticism might find it particularly difficult to follow this recommendation and that a more tailored health recommendations would probably be more successful.

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## Appendix

The 31 Genetic Information (Single Nucleotide Polymorphisms=SNPs) variables used as instruments are; rs4438499_a, rs1527243_c, rs17753893_g, rs4146_t, rs4622449_t, rs8037245_t, rs8087497_a, rs6537651, rs1217228, rs7576944, rs16984966, rs10182333, rs2356798, rs9838033, rs3868899, rs16847028, rs9354878, rs569833, rs7003960, rs4740993, rs488520, rs4878088, rs1441322, rs11029574, rs11030014, rs11157383, rs4904103, rs12593468, rs4780717, rs9966412 and rs4817527.

**Table 3. First Stage Results for Neuroticism**

| Variable | Coefficient | Robust Std E | t-value | p-value |
|---|---|---|---|---|
| **drs4438499_a** | 0.127*** | 0.444 | 2.86 | 0.004 |
| **drs1527243_c** | 0.878** | 0.042 | 2.09 | 0.036 |
| **drs17753893_g** | 0.062 | 0.039 | 1.59 | 0.112 |
| **drs4146_t** | 0.096** | 0.039 | 2.46 | 0.014 |
| **drs4622449_t** | -0.119 | -0.039 | -0.30 | 0.762 |
| **drs8037245_t** | -0.745* | 0.038 | -1.95 | 0.051 |
| **drs8087497_a** | 0.080 | 0.063 | 1.27 | 0.205 |
| **drs6537651** | -0.072* | 0.043 | -1.65 | 0.098 |
| **drs1217228** | 0.086** | 0.038 | 2.25 | 0.025 |
| **drs7576944** | -0.076* | 0.042 | -1.81 | 0.071 |
| **drs16984966** | 0.086** | 0.040 | 2.14 | 0.032 |
| **drs10182333** | 0.112** | 0.046 | 2.43 | 0.015 |
| **drs2356798** | -0.061 | 0.041 | -1.50 | 0.133 |

| | | | | |
|---|---|---|---|---|
| **drs9838033** | 0.085** | 0.042 | 2.05 | 0.041 |
| **drs3868899** | 0.069* | 0.039 | 1.79 | 0.073 |
| **drs16847028** | 0.102** | 0.045 | 2.26 | 0.024 |
| **drs9354878** | -0.060 | -0.390 | -1.55 | 0.122 |
| **drs569833** | 0.090** | 0.038 | 2.36 | 0.018 |
| **drs7003960** | -0.531 | 0.043 | -1.22 | 0.221 |
| **drs4740993** | 0.043 | 0.038 | 1.11 | 0.268 |
| **drs488520** | 0.090** | 0.040 | 2.26 | 0.024 |
| **drs4878088** | -0.574 | 0.042 | -1.37 | 0.172 |
| **drs1441322** | -0.068* | 0.039 | -1.74 | 0.082 |
| **drs11029574** | -0.068* | 0.039 | -1.76 | 0.078 |
| **drs11030014** | -0.052 | 0.039 | -1.33 | 0.184 |
| **drs11157383** | 0.081** | 0.039 | 2.07 | 0.039 |
| **drs4904103** | -0.076* | 0.041 | -1.83 | 0.068 |
| **drs12593468** | 0.084** | 0.041 | -2.03 | 0.042 |
| **drs4780717** | 0.074* | 0.039 | 1.91 | 0.057 |
| **drs9966412** | 0.069 | 0.447 | 1.55 | 0.122 |
| **drs4817527** | -0.055 | 0.041 | -1.32 | 0.186 |
| **Female** | 0.529*** | 0.392 | 13.5 | 0.000 |
| **Age 36-50** | -0.185*** | 0.055 | -3.33 | 0.001 |
| **Age 51 +** | -0.417*** | 0.060 | -6.95 | 0.000 |
| **North** | 0.117 | 0.0727 | 1.61 | 0.108 |
| **South** | 0.091 | 0.0726 | 1.25 | 0.211 |
| **Scotland** | 0.171* | 0.089 | 1.92 | 0.054 |
| **Married** | 0.009 | 0.044 | 0.20 | 0.841 |
| **Degree** | -0.025 | 0.041 | -0.61 | 0.541 |
| **Child Age 0-2** | -0.233*** | 0.084 | -2.79 | 0.005 |
| **Child Age 3-4** | 0.060 | 0.089 | 0.67 | 0.502 |
| **Child Age 5-11** | -0.044 | 0.059 | -0.75 | 0.454 |
| **Child Age 12-15** | -0.203*** | 0.079 | -2.58` | 0.010 |
| **Employed** | -0.176*** | 0.055 | -3.18 | 0.001 |
| **Unemployed** | 0.048 | 0.118 | 0.41 | 0.684 |
| **Income 2nd Quartile** | -0.071 | 0.060 | -1.17 | 0.240 |
| **Income 3rd Quartile** | -0.092 | 0.060 | -1.53 | 0.125 |
| **Income 4th Quartile** | -0.156** | 0.063 | -2.48 | 0.013 |
| **Long standing Health Cond** | 0.385*** | 0.044 | 8.68 | 0.000 |
| **Urban** | 0.126*** | 0.044 | 2.86 | 0.004 |
| Constant | 3.241*** | 0.152 | 21.38 | 0.000 |
| F test for excl. instruments | 3.30 | | | 0.000 |
| Saunderson-Windmeijer Ftest | 3.30 | | | 0.000 |
| Underid SW Chi-sq | 103.24 | | | 0.000 |

*Note*: Robust standard errors and Newey and Windmeijer (2009) standard errors in parentheses for OLS and IV. *** p<0.01, ** p<0.05, * p<0.1. "Weak id F-statistic" is the Cragg-Donald Wald F statistic (a test for weak instruments) with Stock-Yogo weak ID test critical values of 3.89 and 2.19 for 10% and 15% maximal LIML size (assumes IID errors). "Under id P-value" is the P-value for a Kleibergen-Paap rk LM test with a null hypothesis of the reduced form matrix of coefficients is under-identified. The sample size is 5,256 in each regression.