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Cross-country heterogeneity and endogeneity bias in life satisfaction estimations - Macro- and micro-level evidence for advanced, developing and transition countries

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**CROSS-COUNTRY HETEROGENEITY
AND ENDOGENEITY BIAS IN LIFE
SATISFACTION ESTIMATIONS-MACRO-
AND MICRO-LEVEL EVIDENCE FOR
ADVANCED, DEVELOPING AND
TRANSITION COUNTRIES**

Astrid Krenz

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Cross-country heterogeneity and endogeneity bias in life satisfaction estimations—macro- and micro-level evidence for advanced, developing and transition countries

Astrid Krenz, *University of Göttingen* *

Abstract

The past literature found evidence for the presence of endogeneity issues due to individuals' heterogeneity and omitted time-varying variables in the relationship between income and life satisfaction on the micro-level for the UK (Powdthavee (2010)). The aim of the present contribution is to put these results in a broader context and to investigate the role of cross-country heterogeneity and income endogeneity in estimations on life satisfaction for sub-samples of advanced, developing and transition countries. The paper is innovative in merging this methodology with a multi-country setting, particularly considering transition and developing countries. Instrumenting for income, we find that cross-country heterogeneity is associated with a significantly lower estimate for the income effect, whereas controlling for endogeneity bias delivers significantly higher estimates. This points to a negative bias in the OLS estimate, and thus approves previous literature's findings. Capturing endogeneity appears to be essential in studies on life satisfaction. The negative bias apparently is highest for the sub-sample of transition countries and lowest for advanced countries. Most of the macro- and micro-level impacts are in line with the previous literature.

Keywords: Life satisfaction, Income, Endogeneity

JEL-Code: F63, I31, O57

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1 Introduction

The driving forces of life satisfaction have been subject in a great variety of studies in the past. Previous literature's focus is either on the micro- or the macro-level, on different countries, periods of time or on tackling econometric issues, respectively. The literature does, however, only barely investigate the causal relationship between life satisfaction and income. The aim of the present contribution is meant to fill this gap, dealing specifically with a multi-country setting.

Since the contribution of Easterlin (1974), the relationship between income and happiness is probably the most debated open question in happiness research. Easterlin found that the positive relationship between income and happiness diminishes when comparing various countries' income and happiness levels over time. However, in a given country, across individuals, a positive interdependence between income and happiness persists. Several research efforts have been made in the past to figure out the relationship between the two factors.

The debate is still going on, since the past literature found only mixed evidence for the importance of income in generating happiness. A negative relation has been found, for example, by Clark (2003). A positive link has been established in studies by Blanchflower and Oswald (2004) for the UK and the USA and by Winkelmann and Winkelmann (1998) for Germany.

The literature provides several reasonings for potential biases in the income effect for life satisfaction estimations¹. Some reason, for example, lies in the positive correlation of income with other factors like working hours or time for commuting. These factors, in turn, will be negatively related with life satisfaction, such that the effect of income on life satisfaction might be obscured. Apart from these confounding factors, simultaneity might be another source of bias. One could imagine that a happier person will find it easier to receive a higher income, indicating that the interdependence between income and life satisfaction is not just one-sided. These interdependencies point to the major problem that we want to deal with in this article: the explanatory variable income is endogenous itself.

Only a few studies employ an instrumental variables approach which constitutes a procedure to remedy the endogeneity issue. A recent attempt is given by Powdthavee (2010). The author employed the British Household Panel Survey and took up a new instrumental variable for income, namely payslips (either seen or not seen by the interviewer). His results show that individuals' heterogeneity slightly reduces the income effect whereas instrumenting for income renders an almost twice as large estimator than a basic OLS regression would do. Knight et al. (2008) find in a cross-sectional study for rural China that household income estimates rise from 0.17 to 0.58 when income is instrumented. The taken instrumental variables were respondent's father's years of schooling and the value of productive assets. Luttmer (2005) found for the US that the income effect will

¹See Powdthavee 2010 for a good review.

be three times as large as when income is not instrumented. His instrumental variables are based on predicted household earnings through information on occupation and industry affiliation of the individual himself and his spouse. However, the author does not single out the IV estimates in the panel FE estimation, and thus is not delivering information on the relevance of unobserved heterogeneity in life satisfaction estimations. Lydon and Chevalier (2002) use partner's earnings as IV for income, however, in their study they explain the domain of job satisfaction, only.²

Moreover, the literature has investigated a bulk of further factors affecting life satisfaction. As regards the micro-level, there is generally consensus in the literature that the married are more satisfied with life than other family status types (Stutzer and Frey 2006), happiness declines with age in a U-shaped manner (e.g. Clark and Oswald 1996, Blanchflower and Oswald 2004), having children does not seem to exert a robust influence on happiness and being unemployed negatively influences happiness (Clark 2003; Winkelmann and Winkelmann 1998; Di Tella et al. 2001; Blanchflower and Oswald 2004). Further studies find a negative or no significant influence of education for life satisfaction (Clark 2003; Warr 1992; Shields and Wailoo 1999). The explanation behind is that the highly educated might need to reach higher levels of achievement in order to gain a higher life satisfaction compared to the lower educated. On the macro-level, studies suggest that unemployment and inflation (Di Tella et al. 2001) and bad governance (Bjørnskov et al. 2010) negatively influence the overall happiness level. In a cross-country study focussing especially on transition countries, Sanfey and Teksoz (2007) find that income inequality bears a negative impact on life satisfaction in these countries, and measures of GDP per capita and good governance bear a positive one.

In this study, we will employ another set of instrumental variables capturing the potential endogeneity of income in life satisfaction estimations. Based on an analysis employing the combined European and World Values survey, the IV is the household's chief wage earner's job status. We will motivate the choice of the new instrument and provide statistical test results to guarantee for the quality of the instrument. Taking account of income endogeneity in regressions yields higher estimates for the income effect, while controlling for unobserved cross-country heterogeneity leads to lower estimates, which is in accordance with the previous literature. With our study we can show that this relationship is valid for various countries worldwide, alike, with an apparently stronger impact for transition countries and a fewer one for advanced countries. We can suggest then, that controlling for the two sorts of endogeneity is necessary in order to deliver more reliable estimates on the causal relationship between income and life satisfaction.

The paper is organized as follows. Part 2 addresses the data and empirical design. Part 3 presents

²Recent research started focusing on the influence of capabilities for happiness and offers a promising avenue for future research (Anand et al. 2011). In their contribution, the authors also take account of endogeneity and heterogeneity issues. They find that empathy, self-esteem and goal autonomy bear the highest positive influence on life satisfaction; stress, however, bears a negative impact.

the regression results. Part 4 concludes with discussions.

2 Data and empirical design

For our analysis, we employ data from the combined World Values Survey/ European Values Survey data set, as well as from the World Bank's World Development Indicators (2011). The World Value Survey offers a large data set in terms of covered individuals' perceptions of life worldwide. To start with, data from the World Value Survey were extracted for the recent five waves 1981-2008. However, in the process of gathering further explanatory variables for the regression analysis, the observations of wave one and five dropped out of the sample. We therefore conducted regressions with the remaining three waves, covering the years 1989-93, 1994-99 and 1999-2004, respectively. In the following, regressions were run for different samples of countries, spanning all waves and the fourth wave (1999-2004) only, respectively. Since macro-level variables taken from the World Development Indicators were not available for all years, regressions based only on the fourth wave will enable us to include the macro variables. We group countries into advanced, developing and transition countries. The included countries and constructed sub-groups can be reviewed in a list in the appendix.

Life satisfaction is measured employing the variable *All things considered, how satisfied are you with your life as a whole these days?*. Measuring life satisfaction instead of happiness has been proven to be superior in the literature (Veenhoven 2000, Layard 2005), and we will also make use of this measure.

We estimate the following equation

$$LS_{ic} = \alpha + \beta_1 X_{ic} + \beta_2 Y_c + \gamma_c + \delta_t + \epsilon_{ic} \quad (1)$$

by a two-way fixed effects procedure. LS denotes the degree of life satisfaction measured on a 10 point scale (10 = satisfied with life) and is regressed on a set of individual i 's characteristics X , country c 's variables Y , country fixed effects and time fixed effects. ϵ denotes the idiosyncratic error term. Running the two-way fixed effects estimation will control for unobserved heterogeneity due to differences across time and across countries, respectively. In a further step, we will instrument for the income variable and employ a TSLS-estimation methodology, accordingly. This way, we can deal with the bias emerging from time-varying omitted variables and simultaneity.

In line with the previous literature the following explanatory micro-level variables are included in the vector X : income, education, gender, age, marital status, number of children and employment status.³ As there is not enough observations for all of the three waves considered in our analysis,

³See the appendix for further information on the variables.

country-level variables could only be taken up for wave four. Among the macro-level variables Y we include: the Gini coefficient, GDP per capita, the consumer price index (CPI), unemployment (Sanfey and Teksoz 2007, Di Tella et al. 2001), as well as GDP per capita growth, life expectancy and openness (Bjornskov et al. 2008).

Since the individuals' income variable is assumed to be subject to endogeneity, the following instrument has been used⁴. The World Values Survey offers a variable measuring the job status of the chief wage earner in the household. Accordingly, we only considered those individuals in our analysis, who were not chief wage earners but from whom we could retrieve data on the job status of the household's other member being the chief wage earner. We grouped the chief wage earners employees into the categories "manager", "white-collar worker", and "other", respectively (see the following table for the grouping and variable's entries). We considered "other" to be the reference category in our regressions.

Table 1: Classification of job status

Job status	classified as
Employer/manager of establishment with 500 or more employed	Manager
Employer/manager of establishment with 100 or more employed	
Employer/manager of establishment with 10 or more employed	
Employer/manager of establishment w. less than 500 employed	
Employer/manager of establishment w. less than 100 employed	
Employer/manager of establishment with less than 10 employed	
Professional worker	White collar worker
Middle level non-manual office worker	
Supervisory non-manual office worker	
Junior level non-manual	Other
Non-manual office worker	
Foreman and supervisor	
Skilled manual	
Semi-skilled manual worker	
Unskilled manual	
Farmer: has own farm	
Agricultural worker	
Member of armed forces	
Never had a job	
Other	

Source: Job status variable of World Values and European Values survey.
 Note: The variable measures the household's chief wage earner's job status, given that the survey respondent is a non-chief wage earner of the household.

The choice of the instrument is motivated by the following reasoning. An individual's income is assumed to be highly related to the household's chief wage earners's job status. We ground this

⁴Statistical checks for endogeneity also reveal that OLS estimates are biased due to endogeneity of income. The test results are reported in the following regression output tables and in chapter 3.3.

assumption on previous literature’s findings on a relation between the individual’s and partners’ income (e.g. Lydon and Chevallier 2002) or education. The underlying principle in this regard is also known as marital selection (Becker 1973), people sort themselves into couples based on the individuals’ characteristics. Moreover, a partner’s characteristics is said to bear an impact on an individual’s human capital and therewith on his productivity and wages (Benham 1974). Further, as regards the relation between income and job status, we can expect blue collar workers to earn less than managers, for example. Since we suspected that the interviewed individual’s own job status might be correlated with other unexplained factors influencing his life satisfaction, we chose another household member’s job status, instead. By this we think we can better rule out third factors that might affect the validity of the orthogonality condition between the instrument and the error term of the life satisfaction equation. In chapter 3.3 we will also report statistical test results for the instrumental variable to fulfill the exclusion restriction of no direct impact on life satisfaction. Moreover, the job status can be supposed to be unrelated to an individual’s life satisfaction. It is easy to think about a high-income earning manager, as well as a low-income earning farmer who could both achieve the same life satisfaction levels. Also, a farmer who is earning less than a manager might be much happier than the high-income earning manager.^{5 6}

3 Regression results

In the following, we will present our regression results. We start with the analysis of waves two to four, first. The tables display from left to right, OLS, OLS controlling for cross-country heterogeneity, reduced form, and TSLS estimates. In sub-section 3.2, we will concentrate on wave four, only. There, for the full sample and the different three sub-groups of countries we will run the same estimation procedure as described above. In that part of the analysis, we will be able to control for further macro-level variables.

3.1 Waves 2-4

We report the results for the full sample in table 2. The results reveal a positive income effect. Via OLS, the effect of income on life satisfaction is estimated to be 0.176. Taking account of cross-country heterogeneity, the estimate drops to 0.170. Controlling in addition for endogeneity (assuming that the orthogonality condition between income and the error term is met), the TSLS

⁵See Diener and Biswas-Diener (2002) who review reasons for the wealthy people not being necessarily happier than the poor. They refer, for example, to rising desires and expectations, the drawbacks of a materialistic mind, longer working hours, etc.

⁶In our first regressions we considered the individual’s job status as instrument. However, this might invoke a violation of the orthogonality condition between the instrument and the error term out of the life satisfaction equation. The Sargan statistic was also pointing in favor of having taken an inadequate instrument. As an explanation, one could imagine a situation where an individual’s job status might affect the individuals’ other attributes like mental strength or inner incentives which might bear an impact on life satisfaction, but cannot be measured and are therefore not taken up as regressors in the life satisfaction equation.

Table 2: Life satisfaction estimations—all countries

All countries				
Variables	OLS	OLS	reduced form	TSL5
constant	7.427***	7.129***	5.095**	6.075***
income	0.176***	0.170***	-	0.356***
reference low education				
middle education	0.179***	0.159***	0.714**	-0.00999
upper education	0.375***	0.302***	1.396**	-0.0327
male dummy	-0.265***	-0.190***	-0.013	-0.195***
reference age 15-24				
age 25-34	-0.271***	-0.273***	-0.102**	-0.256***
age 35-44	-0.477***	-0.509***	-0.002	-0.521***
age 45-54	-0.482***	-0.590***	0.125**	-0.629***
age 55-64	-0.174***	-0.339***	-0.108**	-0.337***
age 65 and more	-0.0897	-0.230***	-0.443**	-0.168***
reference single				
divorced	-0.508***	-0.382***	-0.265**	-0.332***
living together	0.168***	-0.0248	-0.342**	0.0466
separated	-0.115	-0.210*	-0.313**	-0.151
widowed	-0.328***	-0.0750	0.048	-0.0931
married	0.0785*	0.262***	0.019	0.256***
reference no child				
1 child	-0.0290	-0.0954**	-0.172**	-0.0607
2 children	0.0467	-0.0514	-0.06*	-0.0383
3-5 children	0.0261	-0.0312	-0.096**	-0.00642
6 and more children	-0.0101	-0.0112	-0.283**	0.0590
reference full time				
retired	-0.161***	-0.125***	-0.796**	0.0308
housewife	-0.00223	0.132***	-0.831**	0.294***
part time	0.00419	0.0180	-0.448**	0.101***
self-employed	-0.0618	-0.00397	-0.402**	0.0753*
student	-0.00604	0.0496	-0.725**	0.180***
unemployed	-0.550***	-0.451***	-1.306**	-0.190***
other	-0.0747	0.00207	-0.652**	0.134*
reference wave 2				
wave 3	-0.632***	-0.462***	-0.177**	-0.392***
wave 4	-0.684***	-0.330***	0.231**	-0.335***
reference advanced countries				
developing countries	-0.932***	-1.519	-1.557**	-2.544***
transition countries	-1.984***	-0.187	-1.73**	-2.485***
Instruments				
reference other				
manager	-	-	1.369**	-
white collar worker	-	-	0.84**	-
country dummies	no	yes	yes	yes
Observations	61,407	61,407	61,407	61,407
R-squared	0.141	0.227	0.308	0.204
Durbin-Wu-Hausman statistic, F(1, 61304)			94.75 (0.000)	
Cragg-Donald Wald F statistic			1597.62	
Angrist-Pischke multivariate F test of excluded instruments			1477.47 (0.000)	
Kleibergen-Paap rk LM statistic, Chi-sq(2)			2671.97 (0.000)	
Hansen J statistic, Chi-sq(1)			0.745 (0.3881)	

Source: Own calculations based on data from the World values and European values survey.
 Note: This table displays the estimation results from clustered linear regressions for the full sample of the dependent variable life satisfaction on different micro-level variables. Robust standard errors were calculated. *, ** denote 10 percent and 5 percent levels of significance, respectively. The omitted country variable is the US.

Table 3: Life satisfaction estimations–transition, developing, advanced countries

Variables	Transition countries				Developing countries				Advanced countries			
	OLS	OLS	reduced form	TOLS	OLS	OLS	reduced form	TOLS	OLS	OLS	reduced form	TOLS
constant	4.815***	3.854***	5.954**	1.957***	6.122***	6.558***	3.121**	3.643***	7.432***	7.376***	-	7.000***
income	0.165***	0.166***	-	0.482***	0.206***	0.208***	-	0.353***	0.120***	0.0888***	-	0.185***
reference low education												
middle education	0.0431	0.313***	0.643**	0.0667	0.336***	0.124***	0.799**	-0.0282	-0.0831**	0.00496	0.564**	-0.0664
upper education	0.241***	0.527***	1.193**	0.0445	0.592***	0.248***	1.568**	-0.0426	-0.0816	0.0197	1.296**	-0.144**
male dummy	-0.295***	-0.243***	-0.083**	-0.235***	-0.219***	-0.116***	0.056*	-0.122***	-0.202***	-0.204***	0.018	-0.214***
reference age 15-24												
age 25-34	-0.257***	-0.312***	-0.178**	-0.259***	-0.267***	-0.248***	-0.051	-0.245***	-0.263***	-0.180***	-0.028	-0.176***
age 35-44	-0.761***	-0.755***	-0.285**	-0.675***	-0.269***	-0.325***	0.117**	-0.354***	-0.584***	-0.483***	0.277**	-0.518***
age 45-54	-0.819***	-0.815***	-0.262**	-0.747***	-0.152**	-0.338***	0.285**	-0.395***	-0.754***	-0.640***	0.48**	-0.700***
age 55-64	-0.704***	-0.623***	-0.454**	-0.496***	0.302***	-0.0776	0.192**	-0.123	-0.542***	-0.383***	0.016	-0.399***
age 65 and more	-0.631***	-0.498***	-0.667**	-0.318***	0.326***	-0.0279	0.037	-0.0537	-0.589***	-0.370***	-0.637**	-0.315***
reference single												
divorced	-0.661***	-0.384***	-0.406**	-0.258**	-0.652***	-0.637***	-0.029	-0.629***	0.226	0.103	-0.461**	0.147
living together	-0.225	-0.180	-0.025	-0.179	0.216***	-0.0451	-0.254**	-0.00116	0.665***	0.368***	-0.527**	0.424***
separated	-0.673***	-0.386*	-0.554**	-0.208	0.0964	-0.125	-0.046	-0.119	-0.475*	-0.488*	-1.064**	-0.385
widowed	-0.471***	-0.173	0.088	-0.211*	-0.154	0.0385	-0.122	0.0485	0.241	0.227	-0.155	0.235
married	0.0765	0.198***	-0.143**	0.239***	0.0267	0.262***	0.199**	0.230***	0.578***	0.495***	-0.091	0.502***
reference no child												
1 child	-0.129*	-0.119*	-0.048	-0.101	0.0351	-0.0574	-0.29**	-0.0124	0.0498	-0.0661	-0.041	-0.0584
2 children	-0.0526	-0.0892	0.021	-0.0938	0.119*	-0.0185	-0.164**	0.00817	0.191***	0.0848	0.185**	0.0687
3-5 children	-0.0274	-0.0846	0.043	-0.0861	-0.0393	-0.0614	-0.269**	-0.0165	0.266***	0.0908	0.049	0.0926
6 and more children	-0.391**	-0.462***	0.164	-0.480***	-0.0994	-0.0774	-0.512**	0.0120	0.403**	0.0321	-0.328**	0.0772

Table 4: Life satisfaction estimations–transition, developing, advanced countries CONTINUED

Variables	Transition countries				Developing countries				Advanced countries			
	OLS	OLS	reduced form	TOLS	OLS	OLS	reduced form	TOLS	OLS	OLS	reduced form	TOLS
reference full time												
retired	-0.0831	-0.0660	-0.752**	0.181**	-0.252**	-0.243***	-0.339**	-0.192**	0.305***	0.215**	-1.398**	0.353***
housewife	-0.0314	0.0794	-0.871**	0.361***	0.0205	0.0853*	-0.504**	0.171***	-0.131**	0.0264	-1.523**	0.174**
part time	-0.0445	0.105	-0.513**	0.256***	0.0589	-0.0503	-0.277**	-0.00254	-0.0766	-0.0309	-0.683**	0.0331
self-employed	0.00589	0.0981	-0.357**	0.198*	-0.0711	-0.102*	-0.208**	-0.0614	-0.150*	-0.0326	-0.691**	0.0327
student	0.220***	0.261***	-0.644**	0.455***	-0.148***	-0.0869	-0.547**	-0.00565	-0.0191	-0.00726	-1.08**	0.0898
unemployed	-0.525***	-0.422***	-1.449**	0.0561	-0.577***	-0.482***	-0.962**	-0.324***	-0.698***	-0.678***	-1.761**	-0.498***
other	0.140	0.233**	-0.699**	0.459***	-0.326***	-0.390***	-0.408**	-0.315**	-0.185	-0.230	-1.322**	-0.0958
reference wave 2 or wave 3												
wave 3	-	-	-	-	-0.185***	-0.314***	-0.332**	-0.238***	-0.471***	-0.213	1.578**	-0.333*
wave 4	0.749***	0.378***	0.159**	0.320***	-0.863***	-0.407***	0.283**	-0.417***	-0.495***	-0.103	2.26**	-0.289
Instruments												
reference other												
manager	-	-	1.181**	-	-	-	1.521**	-	-	-	1.367**	-
white collar worker	-	-	0.585**	-	-	-	0.925**	-	-	-	1.06**	-
country dummies	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes
Observations	20,331	20,331	20,331	20,331	29,337	29,337	29,337	29,337	11,739	11,739	11,739	11,739
R-squared	0.099	0.169	0.265	0.096	0.080	0.165	0.301	0.152	0.062	0.109	0.353	0.098
Durbin-Wu-Hausman statistic			52.06 (0.000)					30.01 (0.000)				10.57 (0.001)
Cragg-Donald Wald F statistic			295.8					998.9				414.52
Angrist-Pischke multivariate F test of excluded instrument			280.23 (0.000)					889.09 (0.000)				402.08 (0.000)
Kleibergen-Paap rk LM statistic, Chi-sq(2)			507.66 (0.000)					1581.89 (0.000)				729.03 (0.000)
Hansen J statistic, Chi-sq(1)			0.357 (0.5501)					2.05 (0.1523)				1.523 (0.217)

Source: Own calculations based on data from the World values and European values survey.

Note: This table displays the estimation results from clustered linear regressions of the dependent variable life satisfaction on different micro-level variables. Robust standard errors were calculated. *, ** denote 10 percent and 5 percent levels of significance, respectively. The omitted country variables are the US in case of advanced countries, Russia in case of transition countries and Colombia in case of developing countries.

estimate jumps up to 0.356, which is about two times as large as the OLS estimate. The overall bias is obviously negative. This is in line with the previous literature. As Powdthavee (2010) explains, omitted factors that are correlated positively with income will lead to a negative impact on life satisfaction (like working hours, for example). Identification in the IV estimation is achieved by controlling for the household's chief earner's job status and further variables in the income equation.

Other results are mostly in line with previous findings in the literature. We can detect a U-shaped relationship between life satisfaction and age and a positive effect for the married people. The effect on life satisfaction due to having children is not clear, being unemployed decreases life satisfaction. The results further show that life satisfaction scores decreased over time, and developing and transition countries generally record lower life satisfaction scores than advanced countries. As regards the level of education, in simple OLS regressions the effect for life satisfaction is positive. However, once instrumenting for income—and income is highly positively dependent on educational levels—we obtain a negative, though non-significant relationship between education and life satisfaction, which is in line with the literature (e.g. Clark 2003, Warr 1992, Shields and Wailoo 1999).

Comparing regression results across different sub-samples of countries delivers interesting insights. Overall, the relationship between income and life satisfaction described already in the text above, is found to exist for all sub-samples of countries. More precisely, results for separate groups of countries display that the income effect is lowest for advanced countries and highest for transition countries, once income is instrumented for via TSLS regression.

In the case of transition countries, various impacts differ from the full sample. Controlling for endogeneity, results reveal that housewives and the retired score higher life satisfaction levels. The results suggest that the negative (insignificant) effects otherwise found in simple OLS regressions might emerge from the endogeneity of income. In fact, housewives and the retired earn less, as the reduced form estimations show, so the effects for the retired and the housewives are channeled through lower income. Being unemployed does not show a significant effect on life satisfaction once income is instrumented for. Here, the negative effect might be absorbed for most part by the effect of individual unemployment on lower income. As in Sanfey and Teksoz (2007), the self-employed and students appear to be happier, once we control for endogeneity of income. Further, life satisfaction levels increased from wave 3 to wave 4. Education is not significant in explaining life satisfaction.

For the developing countries a negative, though insignificant effect for education emerges in the TSLS estimates. Having more children is associated with an individual's fewer income, it does not appear to induce higher happiness levels. Results reveal that life satisfaction decreased over time.

Table 5: Life satisfaction estimations-wave 4 only

Variables	All countries			Transition countries			Developing countries			Advanced countries		
	OLS	Reduced form	TOLS	OLS	Reduced form	TOLS	OLS	Reduced form	TOLS	OLS	Reduced form	TOLS
constant	3.011***	4.917**	2.423***	-2.242***	13.501**	-4.494***	3.670***	4.167**	3.073***	24.49***	10.061**	24.09***
income	0.185***	-	0.298***	0.186***	-	0.344***	0.219***	-	0.351***	0.109***	-	0.143***
reference low education												
middle education	0.0878***	0.716**	-0.0186	0.321***	0.614**	0.197***	0.177***	0.774**	0.0390	-0.0843*	0.602**	-0.112*
upper education	0.306***	1.267**	0.113**	0.570***	1.133**	0.329***	0.414***	1.26**	0.183**	-0.121**	1.383**	-0.182**
male dummy	-0.267***	-0.068**	-0.263***	-0.281***	-0.137**	-0.267***	-0.247***	-0.006	-0.244***	-0.126**	0.079	-0.131**
reference age 15-24												
age 25-34	-0.235***	-0.117**	-0.225***	-0.303***	-0.255**	-0.268***	-0.234***	-0.058	-0.232***	-0.225***	0.084	-0.226***
age 35-44	-0.464***	0.043	-0.478***	-0.715***	-0.404**	-0.660***	-0.299***	0.169**	-0.333***	-0.535***	0.361**	-0.549***
age 45-54	-0.538***	0.18**	-0.570***	-0.818***	-0.392**	-0.767***	-0.245***	0.3064**	-0.302***	-0.753***	0.597**	-0.776***
age 55-64	-0.233***	-0.031	-0.244***	-0.644***	-0.544**	-0.572***	0.0698	0.319**	0.00712	-0.450***	0.08	-0.456***
age 65 and more	-0.172**	-0.406**	-0.140*	-0.535***	-0.807**	-0.424***	0.0683	0.003	0.0451	-0.540***	-0.461**	-0.526***
reference single												
divorced	-0.596***	-0.224**	-0.567***	-0.286*	-0.425**	-0.213	-0.754***	-0.069	-0.739***	0.271	-0.154	0.275
living together	0.374***	-0.399**	0.422***	-0.131	-0.236	-0.0961	0.382***	-0.372**	0.435***	0.749***	-0.321**	0.760***
separated	-0.302*	-0.497**	-0.245	-0.152	-0.407*	-0.0743	-0.162	-0.478**	-0.0994	-0.422	-0.889**	-0.394
widowed	-0.293***	0.135	-0.312***	0.0427	0.194	0.00936	-0.154	-0.019	-0.156	0.162	-0.046	0.162
married	0.00242	0.056	-0.00387	0.260**	-0.064	0.271**	-0.0187	0.137**	-0.0378	0.519***	0.038	0.516***
reference no child												
1 child	0.0904*	-0.178**	0.114**	-0.139	-0.169*	-0.111	0.0883	-0.212**	0.124	0.0523	-0.003	0.0536
2 children	0.184***	-0.086*	0.195***	-0.0839	-0.075	-0.0741	0.215***	-0.179**	0.243***	0.173**	0.278**	0.165**
3-5 children	0.250***	-0.129**	0.270***	-0.0668	-0.006	-0.0597	0.145*	-0.312**	0.194**	0.226**	0.157	0.224**
6 and more children	0.258***	-0.35**	0.310***	-0.251	0.005	-0.236	0.0901	-0.572**	0.182*	0.292	-0.301*	0.308

Table 6: Life satisfaction estimations—wave 4 only CONTINUED

reference full time												
retired	-0.163***	-0.833**	-0.0651	-0.0725	-0.851**	0.0686	-0.0659	-0.306**	-0.0331	0.303***	-1.209**	0.344***
housewife	-0.0633	-1.037**	0.0558	0.120	-1.029**	0.284***	-0.120*	-0.591**	-0.0358	-0.0552	-1.579**	-0.00172
part time	-0.0473	-0.601**	0.0199	0.0207	-0.659**	0.121	0.0737	-0.517**	0.145*	-0.166***	-0.699**	-0.143**
self-employed	0.0238	-0.521**	0.0835	0.0522	-0.297**	0.0790	-0.0332	-0.278**	0.00816	-0.195*	-0.632**	-0.172
student	0.123***	-0.861**	0.213***	0.229**	-0.736**	0.330***	0.0992	-0.63**	0.180**	-0.0968	-0.867**	-0.0702
unemployed	-0.545***	-1.404**	-0.373***	-0.447***	-1.613**	-0.179	-0.485***	-1.05**	-0.328***	-0.701***	-1.752**	-0.639***
other	0.105	-0.581**	0.175**	0.264*	-1.078**	0.432**	-0.320**	0.252**	-0.341***	-0.339*	-1.189**	-0.298
Macro variables												
Gini Index	0.0130***	0.002**	0.0129***	0.00539**	-0.022**	0.00874***	0.0143***	0.0003	0.0143***	0.00178	0.028**	0.000901
Gdp per cap growth	-0.145***	0.027**	-0.146***	-0.261***	0.061**	-0.268***	0.0722***	-0.01	0.0744***	-0.0708**	-0.043	-0.0688**
CPI	0.00174***	0.0004	0.00157***	0.0208***	-0.021**	0.0241***	-0.00945***	0.005**	-0.0103***	-0.0475***	-0.022*	-0.0469***
Life expectancy	0.0315***	-0.006**	0.0324***	0.111***	-0.096**	0.128***	0.0108***	-0.008**	0.0122***	-0.156***	-0.023	-0.154***
Gdp per cap	0.00003***	0.00003**	0.00002***	0.00001	0.0001**	-0.00001	0.000103***	0.0001**	0.0001***	-0.00001	-0.00001**	-0.000004
Unemployment	-0.0263***	0.011**	-0.0273***	-0.0815***	0.056**	-0.0903***	-0.0124***	0.01**	-0.0136***	-0.0821***	-0.169**	-0.0757***
Trade ratio	0.00292***	-0.004**	0.00340***	-0.00113	-0.012**	0.000439	0.00996***	-0.002**	0.0103***	0.00102***	-0.002**	0.00109***
Instruments												
reference other												
manager	-	1.495**	-	-	1.459**	-	-	1.779**	-	-	1.247**	-
white collar worker	-	0.912**	-	-	0.681**	-	-	0.961**	-	-	1.076**	-
Observations	36,966	36966	36,966	10,634	10,634	10,634	17,848	17,848	17,848	8,484	8484	8,484
R-squared	0.156	0.221	0.147	0.154	0.236	0.136	0.148	0.204	0.137	0.091	0.323	0.090
Durbin-Wu-Hausman statistic		23.36 (0.000)						17.15			0.85	
								(0.000)			(0.355)	
Cragg-Donald Wald F statistic		1046.59						654.95			276.34	
Angrist-Pischke multivariate F test of excluded instruments		958.26 (0.000)						223.65 (0.000)			582.47 (0.000)	
											267.21 (0.000)	
Kleibergen-Paap rk LM statistic, Chi-sq(2)		1717.79 (0.000)						383.9 (0.000)			1000.04 (0.000)	
											490.19 (0.000)	
Hansen J statistic, Chi-sq(1)		3.726 (0.054)						0.149 (0.6992)			4.824 (0.028)	
											5.254 (0.0219)	

Source: Own calculations based on data from the World values and European values survey, and the World Bank Development Indicators 2011.

Note: This table displays the estimation results from clustered linear regressions for wave 4 only. The dependent variable is life satisfaction. Micro- and macro-level variables are included in regressions. Robust standard errors were calculated. *, ** denote 10 percent and 5 percent levels of significance, respectively.

In the advanced countries, education bears a negative effect for life satisfaction. This supports previous literature's findings on developed countries, suggesting that expectation levels of the highly educated are increased (Clark 2003, Warr 1992, Shields and Wailoo 1999). The housewives appear to be happier once income is instrumented for. Life satisfaction levels decreased over time.

3.2 Wave 4

In order to control for macro-level variables in the regression framework, we have to reduce our sample to the use of wave four, only. The macro-level variables are taken from the World Bank Development Indicators for the period 1999-2004. For each macro-economic factor an average value was constructed over this time span. Further, contrary to the previous regressions, here no country and time dummies are included. This way, cross-country heterogeneity is not controlled for. Only the endogeneity issue due to omitted variables or simultaneity is being tackled.

As can be seen from table 5, the TSLS estimate of the income effect is almost two times as large as the OLS estimate (except for advanced countries). The largest effect results for the transition countries. The results discovered before on endogeneity appear to be robust. A negative or no significant relationship for education holds for all countries for a middle level of education (except for advanced countries), a U-shaped relation with age exists, the influence of children on life satisfaction appears to be positive for developing countries and the full sample (channeled through a negative effect on income), and the unemployed are unhappier. The effect for the retired and the housewives tends to diminish, in the analysis based on wave four, only. As regards the macro-variables, unemployment bears a negative effect, openness a positive effect, a higher life expectancy bears a positive effect (except for advanced countries), GDP per capita growth bears a negative effect (except for developing countries), inflation is detrimental to life satisfaction in developing and advanced countries, and higher inequality displays a positive impact.

As regards the effects of the macro-level variables, two results might be surprising: on the one hand the negative effect of GDP per capita growth, on the other hand the positive effect of income inequality. An explanation for the latter might be that greater opportunities and individuals' expectations to increase their future income exist, which boost the degree of life satisfaction (Bjornskov et al. 2008). A higher level of growth, on the other hand, is found in the literature (DiTella et al. 2003) to have a positive impact on life satisfaction. The negative influence found in our study could be explained by economic and social unrest that might be induced by an overheating economy (Bjornskov et al. 2008).

3.3 IV quality

For our study, investigating the need of taking an IV approach and testing for the quality of the instrumental variables are of major concern. We conducted several statistical tests, which we will refer to in the following (see for example Wooldridge 2001).

First, by a Durbin-Wu-Hausman test, we check for the hypothesis that the explanatory variables are uncorrelated with the residual term of the life satisfaction equation. If we have to reject the hypothesis, this will indicate that we have endogenous regressors.

Remember that in our analysis the instruments for income are the state of being a manager or a white collar worker in contrast to other job positions, respectively. To control for the quality of the instrumental variables, on the one hand we will have to check for the validity of the overidentifying restrictions. To do this, we have to investigate whether the orthogonality condition between the instruments and the residual in the structural equation is met. Therefore, we will employ the Hansen test statistic. If we have to reject the hypothesis that no instrument is having an effect in the structural equation, we would know that there exists apparently a misspecification and the instruments would be of low quality, only.

Moreover, the instruments should be fair enough to produce exogenous variation in income. Consequently, we will have to test for the weakness of instruments. To do this, we compute on the one hand the Cragg-Donald Wald F test to check for weak identification. Further, we check for the identification of the reduced form equation by providing the Angrist-Pischke and the Kleibergen-Paap test. This way we can check whether the excluded instruments are correlated with the endogenous regressor, the null hypothesis is underidentification.

The results in tables 2-6 strongly suggest that income is endogenous in the life satisfaction equations (we reject the hypothesis that the income variable is uncorrelated with the error term of the structural equation). Only in case of advanced countries for the sample of wave four, we fail to reject the hypothesis (p-value 0.355). So, in that case OLS appears to be a consistent, and more efficient estimation method than TSLS. The Cragg-Donald Wald F statistic is in favor of rejecting the null hypothesis of weak instruments in all sub-samples and regressions. Further, the Angrist-Pischke and Kleibergen-Paap test statistics suggest that we can reject the null hypothesis of underidentification for the income equation. As regards the test on overidentifying restrictions, the Hansen test statistic bears high, statistically insignificant p-values in the regressions including all waves, therefore pointing to the validity of the orthogonality condition. In case of the wave four regressions for the full sample, we would accept the null hypothesis only at the 5 percent level, and for the developing and advanced countries only at the 1 percent level. This suggests, that we should interpret the TSLS-estimates especially for developing and advanced countries of wave four with some caution.

Summarizing, the chosen variables seem to produce robust instruments for income in the estimations of life satisfaction, especially in the case of the sample involving all waves.

4 Conclusions

The present contribution aimed at investigating the effects that occur when controlling for cross-country heterogeneity and endogeneity bias in the relationship between income and life satisfaction within a multi-country setting. Our analysis is based on data from the European and World Values Survey, and we used a new instrumental variable which is the household's chief wage earner's job status. We provided evidence for the quality and validity of the instrument, conducting several statistical tests. Controlling for endogeneity, the estimates for the income effect vary by up to a factor of 0.5 in advanced countries and by a factor of three in transition countries compared to basic OLS regressions. This suggests that a negative bias in the estimate for the income effect is persistent for all sub-samples of countries. The results back recent evidence found by only a few studies on the causality between income and life satisfaction in the literature on the micro-level. In line with these results, this study suggests that income will be correlated with other unobserved factors that negatively influence life satisfaction. Therefore, we recall that controlling for endogeneity is necessary in studies on life satisfaction. Further, we can assume that compensatory packages (see for example Oswald and Powdthavee (2008)) might be overestimated for countries if endogeneity issues are not taken into account. This appears to be especially the case for transition countries. By our study, controlling for endogeneity, we can confirm the persistent relevance that income plays in explaining individual happiness. This effect, however, appears to be lowest in the advanced countries.

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Appendix

Table 7: List of countries

<i>Variables</i>	<i>Description</i>
advanced countries	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Greece, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, United States
developing countries	Algeria, Argentina, Bangladesh, Brazil, Chile, China, Colombia, Dominican Republic, Egypt, El Salvador, India, Indonesia, Iran, Iraq, Jordan, Malta, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Puerto Rico, Saudi Arabia, South Africa, Tanzania, Turkey, Uganda, Uruguay, Venezuela, Viet Nam, Zimbabwe
transition countries	Albania, Armenia, Azerbaijan, Belarus, Bosnia, Bulgaria, Croatia, Czech Republic, Croatia, Estonia, Georgia, Hungary, Kyrgyzstan, Latvia, Lithuania, Macedonia, Poland, Moldova, Romania, Russia, Serbia, Slovakia, Slovenia, Ukraine

Table 8: List of variables

<i>Variables</i>	<i>Description</i>
life satisfaction	"All things considered, how satisfied are you with your life as a whole these days?", scaled from 1(dissatisfied) to 10 (satisfied), World Values and European Values survey
income	Scale of incomes, scaled from 1 (lower step) to 10 (tenth step), World Values and European Values survey
education	a three level index recoded from X025 (Highest educational level attained) on a country basis, given by lower level, middle level and upper level, dummy variables used for the three categories, World Values and European Values survey
gender	dummy variable, 1= male 0= female, World Values and European Values survey
age	age recoded, dummy variables used for the categories, World Values and European Values survey
family status	marital status, dummy variables used for the categories, World Values and European Values survey
number of children	How many children do you have?, dummy variables used for different classes of numbers of children, World Values and European Values survey
employment status	employment status, dummy variables used for the categories, World Values and European Values survey
job status	In which profession/occupation do you or did you work? If more than one job, the main job? What is/was your job there? , classification scheme used (see table 1 in the text), dummy variables taken for the different classes, World Values and European Values survey
Gini coefficient	World Development Indicators 2011, Gini index, 0=equality 100= inequality
GDP per cap. growth	World Development Indicators 2011, growth rate of GDP per cap.
CPI	World Development Indicators 2011, consumer price index
life expectancy	World Development Indicators 2011, life expectancy, total
GDP per cap.	World Development Indicators 2011, GDP per capita, PPP, current international US dollars
unemployment	World Development Indicators 2011, total unemployment
openness	World Development Indicators 2011, openness index, sum of exports and imports in relation to GDP

Table 9: Descriptive Statistics for all countries for wave 4

Variable	Obs	Mean	Std. Dev.	Min	Max
macro-level variables:					
unemployment	36966	10.42941	7.530097	0	33.48333
trade ratio	36966	81.06246	63.41484	0	389.3
life expectancy	36966	70.22404	8.593778	42.33333	81.41666
CPI	36966	76.19562	26.45878	0	101.2667
GDP per capita	36966	12160.73	11982.43	0	62238.85
GDP per capita growth	36966	2.820572	2.317438	-6.566667	8.133333
Gini index	36966	28.90892	17.83648	0	57.8
advanced country	36966	.2295082	.4205223	0	1
developing country	36966	.4828221	.4997116	0	1
transition country	36966	.2876698	.4526825	0	1
micro-level variables:					
life satisfaction	36966	6.361305	2.557688	1	10
White-collar worker	36966	.3110155	.4629154	0	1
Manager	36966	.0982254	.2976232	0	1
Other job status	36966	0.5907591	0.4916938	0	1
male dummy	36966	.2776064	.4478242	0	1
age 15-24	36966	.2550993	.4359229	0	1
age 25-34	36966	.2642428	.4409352	0	1
age 35-44	36966	.192393	.3941854	0	1
age 45-54	36966	.1311746	.3375958	0	1
age 55-64	36966	.0902721	.2865751	0	1
age 65 and more	36966	.0668182	.2497102	0	1
divorced	36966	.0173132	.1304374	0	1
living together	36966	.0372504	.1893775	0	1
separated	36966	.008846	.0936373	0	1
widowed	36966	.0310015	.1733239	0	1
married	36966	.5938971	.4911108	0	1
single	36966	.3116918	.4631909	0	1
no child	36966	.3413948	.474184	0	1
1 child	36966	.140237	.3472374	0	1
2 children	36966	.2385165	.4261822	0	1
3-5 children	36966	.2347022	.4238183	0	1
6 and more children	36966	.0451496	.207635	0	1
retired	36966	.0852675	.2792832	0	1
housewife	36966	.2519342	.4341295	0	1
part time	36966	.0796678	.2707819	0	1
full time	36966	.2404913	.4273876	0	1
self employed	36966	.0623275	.2417528	0	1
student	36966	.1236271	.3291601	0	1
unemployed	36966	.1374236	.3442986	0	1
other employment status	36966	.0192609	.1374426	0	1
lower education	36966	.3842179	.4864164	0	1
middle education	36966	.4310447	.495229	0	1
upper education	36966	.1847373	.3880896	0	1
income	36966	4.926013	2.412357	1	10
number of countries	66				

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