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Auteurs

Marie Blaise, Laetitia Dillenseger

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Informal caregivers and life satisfaction: Empirical Evidence from the Netherlands

Marie Blaise [a] Laetitia Dillenseger [ab*]

[a] *Faculty of Economics and Management, Bureau d'Economie Théorique et Appliquée, Strasbourg University, France*

[b] *Erasmus Happiness Research Organisation, Erasmus University Rotterdam, The Netherlands*

The impact of informal care provision on life satisfaction remains an unsolved puzzle: because of reverse causality and time-varying unobserved variable biases, simple cross-sectional estimations or fixed-effect models may provide unclear picture of the causal relation between the informal care supply and life satisfaction. Using panel data from the Longitudinal Internet Studies for the Social Sciences (LISS) for the Netherlands over the period 2009-2018, we first estimate a simple Ordinary-Least-Square (OLS) model with fixed-effect analysing the impact of informal care on caregivers' life satisfaction. We then use an Arellano-Bond system Generalized-Method-of-Moments (GMM) model to address endogeneity issues. We find that taking into account an endogeneity bias slightly increases the negative impact of providing informal care on life satisfaction compared with an OLS with fixed-effects approach. Additionally, the detrimental effect of providing care is larger for women, individuals being in co-habitation with children, and unemployed individuals. Among caregivers, providing support to someone living in the same household or being a family caregiver has a stronger negative impact on life satisfaction.

JEL Classification: D10; I10; I31
Keywords: Informal care; satisfaction; happiness; generalized method of moments; the Netherlands

*Correspondence to: Faculty of of Economics and Management, Strasbourg University, 61 Avenue de la forêt noire, 67000, Strasbourg, France. E-mail: ldillenseger@etu.unistra.fr

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1 Introduction

An important minority of the European population, estimated by Verbakel et al. (2017) at 34,4%, of individuals provide informal care for older people, working age adults, young people and children with disabilities, as well as for people living with mental health problems. This trend is likely to increase against a background of Europe's ageing population and growing needs for long-term care. For policy makers, informal care is seen as a cost-effective way of preventing institutionalization and enabling care recipients to remain at home. These advantages, however, may be offset by the indirect costs of care giving, such as reduced employment, possible loss in human capital, and higher health-care expenditures for caregivers. Additionally, informal care provision can generate psychological and physical costs as it is mentally stressful, time-consuming, and physically exhausting, which might in turn affect caregivers' life satisfaction (Bauer & Sousa-Poza, 2015).

Our main objective in this paper is to estimate the causal impact of informal care provision on caregivers' life satisfaction. We examine how caregivers' life satisfaction may vary depending on the extensive margin of care, the type of care provided, and the caregivers' relationship with the care recipient.

The majority of studies on the effects of providing informal care on life satisfaction are subject to methodological shortcomings for example. For example, they use cross-sectional databases (Borg & Hallberg, 2006; Raschick & Ingersoll-Dayton, 2004; Van Den Berg & Ferrer-i Carbonell, 2007) and do not deal with endogeneity bias (Leigh, 2010). The effect of caregiving on life satisfaction may, however, suffer from an upward bias induced by the failure to control for the *family effect* (Bobinac et al., 2010): the health status of the care recipient directly affects her relatives' life satisfaction. The relation may also be downward-biased by the simultaneity between life satisfaction evaluation and the choice to provide informal care: individuals who are more satisfied might tend to provide care more often.

In this paper, we attempt to fill this gap by estimating the causal effect of providing care on Dutch caregivers' life satisfaction, while controlling for several sources of endogeneity. Using data from the Dutch Longitudinal Internet Studies for the Social Sciences (LISS), we analyse whether respondents' life satisfaction could be explained by the informal care provision to their family members or close relatives, for the period 2009 to 2018 in the Netherlands. The dependent variable, representing respondents' satisfaction with life, is scored from zero, completely dissatisfied, to ten, completely satisfied, and the main variable of interest is a dummy variable indicating whether respondents had helped someone in the last twelve months. We first estimate this relationship using an OLS with fixed-effects model. Secondly, we assume that the decision to care is not taken exogenously, and we estimate a dynamic model using a two-step system GMM estimator that allows us to control for several sources of endogeneity, namely simultaneity, unobserved heterogeneity, and dynamic endogeneity.

We aim to contribute to the literature by identifying the causal impact of informal care provision on caregivers' life satisfaction. The second contribution of this paper is the case study of the Netherlands. The political context is all the more interesting as between 2007 and 2015 the Dutch government undertook a normative reorientation towards greater individual responsibility in long-term care. These reforms have been implemented to shift the

responsibility of care towards the family and/or the local community. According to Maarse and Jeurissen (2016), the unexploited potential of informal caregivers has been overestimated. The new arrangement may make informal care an obligation, even while caregivers are offered limited opportunities to arrange their work hours accordingly. To the best of our knowledge, only Van Den Berg and Ferrer-i Carbonell (2007) have focused on Dutch caregivers by analysing the monetary value of providing informal care using a well-being valuation method, but they use cross-sectional data and so do not deal with endogeneity biases. Further, we appear to be the first to carry out a detailed analysis of the degree of heterogeneity in the effect of informal care provision on caregivers with respect to various socio-demographic characteristics and informal care specificities.

Our main findings suggest that providing informal care reduces caregivers' life satisfaction on average by a 0.09 points. A secondary result is that the current life satisfaction of caregivers depends on their past positive realization of life satisfaction, meaning that respondents' life satisfaction today relies on how they were in the past.

The remainder of this paper is organized as follows. The rest of the first section presents the existing literature on the relationship between informal care, life satisfaction and health outcomes. We then describe our data and some descriptive statistics in Section two. Our empirical strategy, both the OLS with fixed-effects specification as well as the two-step system GMM, are described in Section three. We present our empirical results including estimations from our baseline specification and an exploration of the potential sources of heterogeneity that may occur in the relationship between informal care and life satisfaction in Section four. The robustness tests are reported in Section five. The paper concludes in Section six.

1.1 Caregiving and health outcomes

Informal care and the carer's psychological health are linked because caregiving implies perceived overload due to the difficulty of combining leisure time, family duties, work demands and care tasks, and because the decline in health status of the care recipient affects one's emotions negatively. In this regard, in a review of the literature Schulz et al. (1990) indicate that caregivers tend to show an above-average level of psychiatric symptoms. Additionally, Bom et al. (2019) summarise different studies showing that caregiving results in higher prevalence of depressive feelings and a lower mental health scores. Estimates of the physical health effects of informal care are more ambiguous. Caregiving requires physically demanding duties to be carried out over a long duration, thus it might lead to an unhealthy life style, stress and lower psychological health, possibly inducing hypertension and cardiovascular diseases (Pinquart & Sörensen, 2007).

Informal caregivers are not all equal when it comes to health issues. An extended literature highlights how the impact of caregiving on physical and mental health varies depending on specific socio-demographic characteristics. For instance, providing informal care to close family members induces a larger subjective burden than caring for non-family members (García-Castro et al., 2019; Kramer, 1997). Furthermore, dealing with several other duties on top of caregiving increases the perceived feeling of the size of the caregiving burden. Thus, the negative health effect of caregiving is larger for married individuals (Bom et al., 2019) and working female caregivers (Kenny et al., 2014). According to Llacer et al.

(2002), spouse caregivers have a lower socioeconomic status, poorer health and a lower level of well-being than child caregivers; however, child caregivers are significantly more burdened. The intensity of care also matters. Pinquart and Sörensen (2007) find that both the care recipients' behavioral problems, e.g., disruptive and aggressive behavior, and the time spent on caregiving, place a burden on the caregiver and increase symptoms of depression, with aggressive behavioral problems being particularly important when caring for people with dementia. Additionally, they point out that the most severe physical impairments are more likely to occur for older male caregivers in charge of dementia patients, while women bear higher psychological costs due to a higher perceived care burden.

The adverse impact of caregiving, however, can be softened by the use of psychological resources such as mastery, coping strategies, social support, and having sufficient financial resources. Jansson et al. (1997) demonstrate that informal caregivers meeting other caregivers in the same situation increases their spirit of community, their knowledge of caregiving and their ability to handle their personal situations. Lin et al. (2013) provide evidence that the correlation between caregivers' duties and the caregivers' level of depression is weaker when participants have a high level of feedback from others or have a good parent-child relationship. In another study, García-Castro et al. (2019) find that caregivers experiencing the greatest burden are those who perceive they have decreasing leisure time and are under high financial stress. They also find that personality traits such as hope, zest, social intelligence and love mediate the relationship between perceived stress and care burden.

The process of caring may generate negative feelings like stress because it is physically and mentally demanding. This process creates a perceived burden that varies depending on the other duties that caregivers have to discharge, and on the psychological, financial and external resources they have at their disposal.

Some studies highlight the positive effects of providing care. Caregivers can derive positive utility from the process of caring itself, through an increase in self-esteem or by developing an affinity with the care recipient. Cohen et al. (2002) find that caregiving is associated with positive aspects such as companionship and a sense of it being fulfilling and rewarding.

1.2 Caregiving and life satisfaction

Few researchers have analysed the effect of providing informal care on subjective well-being. Most of the studies dealing with this topic focus on health outcomes. Since the seminal article of the American economist Easterlin (1974), the economists' theoretical debate on utility has shifted from an objective approach based on the concept of decision utility to an acceptance of a subjective approach. In this context, economists consider that subjective well-being can be used as a proxy for measuring subjective utility. According to the four-fold quality-of-life matrix developed by Veenhoven (2000), both concepts concern the inner qualities of individuals. Subjective well-being implies inner appreciation of life, while health is an individual objective condition for achieving well-being. However, these are different conceptions of quality of life. The former implies a self-appraisal of one's overall life while, the latter focuses on the degree to which one's life meets the explicit normative standards of what defines a "good life". Thus, subjective well-being reflects one's past experiences, cognitive appreciation of life, and overall feelings of pleasure and pain. Moreover, the development of

measures of social progress and well-being that go "beyond GDP" has seen a boom in recent decades. New measures of GDP have been proposed in policy circles, such as the better Life Initiative in 2011 (OECD, 2011; Korreveski, 2011): this framework measures well-being by considering 11 dimensions covering both current material conditions and quality of life, among it includes a measure of satisfaction with life. An OECD report in 2015 (Durand, 2015) demonstrates the validity of this indicator. Bond and Lang (2018), however, show that ordered Probit findings can be reversed by lognormal transformations. Kaiser and Vendrik (2020) answer this criticism by arguing that Bond and Lang's reversal conditions imply that respondents answer happiness questions in a manner that is implausible and which is contradicted by previous empirical research. Additionally, they show that these reversals are due to heterogeneity across the distribution of reported happiness measures.

Collecting data on informal caregivers in Sweden, Borg and Hallberg (2006) determine that a high frequency of caregiving decreases life satisfaction, while no significant difference exists between less-frequent caregivers and non-caregivers. Using panel data from the Household, Income and Labour Dynamics in Australia survey (HILDA), Leigh (2010) studies the effect of informal care for an elderly or disabled person on labor market outcomes, including life satisfaction. He finds that informal caregivers have a lower level of life satisfaction than non-carers, although this effect becomes insignificant when individual fixed-effect are taken into account. In contrast, Bookwala (2009), based on a US sample of adult daughters and sons, finds that female caregivers' life satisfaction increases over time, and that women caregivers report significantly higher levels of life satisfaction than men caregivers. Finally, Van Den Berg and Ferrer-i Carbonell (2007) assess the compensating variation necessary to maintain the same level of well-being among Dutch informal caregivers. They estimate that an extra hour of informal care is worth about nine to ten Euros, falling to about eight to nine Euros if care recipient is a family member and to about seven to nine Euros if not.

2 Empirical strategy

Our aim is to estimate the impact of informal care provision on the life satisfaction of caregivers. Using a standard linear fixed-effects[1] estimation, our model is specified such that:

$$LS_{it} = \beta_0 + \beta_1 C_{it} + \beta_2 X_{it} + \alpha_i + \lambda_t + \epsilon_{it} \tag{1}$$

LS_{it} is the life satisfaction of individual i at time t, C_{it} represents the decision to care for any caregiver's family member or close relatives, and X_{it} is a vector of socioeconomic controls. α_i, λ_t and ϵ_{it} represent, respectively, individual specific time-invariant effects, time fixed-effects, and the error term.

We used a linear fixed-effects estimation to control for fixed unobserved heterogeneity under the assumption of strict exogeneity of covariates. This analytic approach is commonly used in economic analyses of the correlates of well-being using panel data (Ferrer-i Carbonell & Frijters, 2004). It allows researchers to control for unobserved characteristics that do not

[1]The results of the Hausman test points us to the use of fixed-effects, see Table B.1.1.

change over time, such as personality traits, that are likely to affect both one's life satisfaction and socioeconomic variables.

We suspect that several sources of endogeneity might bias our estimation. Firstly, we might face a problem of simultaneity between the decision to care and life satisfaction. More particularly, the care variable is likely to be a function of life satisfaction and its lags. Indeed, we might think that life satisfaction also impacts the probability of providing care.

Another source of endogeneity that might interfere in our results is linked to missing information. In particular, we analyse the causal relationship between the decision to care and the caregiver's life satisfaction, but we do not observe the health status of the care recipient. Thus, not being able to consider a relevant variable such as the health of the care recipient is likely to affect our results in a twofold way. Firstly, the literature highlights the relevance of observing the health status of the care recipient insofar as it may impact both the caregiver health as well as his probability of providing support. Consequently, an individual becoming dependent affects both the well-being of his potential caregiver and his own probability of being cared for, creating in our case an unobservable shock. Secondly, not only is this shock unobservable, but it is also likely to induce an overestimation of our caregiving estimate. Hence, the caregiver might report being unsatisfied not only because of his caregiving duties but also due to his relative health. Bobinac et al. (2010) deal with this distinction by referring to what they call the *family effect* and the *caregiving effect*. The former represents the fact that individuals' well-being is directly influenced by their close relatives' health whether or not they provide care, while the latter is about the welfare effects of the caregiving activity. As mentioned above, providing care to close family members or relatives may produce negative feelings, since caregivers witness both their physical and mental impairments. These authors show that not accounting for the family effect –the health status of the care recipient–overestimates the care effect by 30%. Following Bobinac et al. (2010), we suspect that missing information on the mental and physical health of the care recipient is likely to skew our results.

Panel-based GMM methodology can be used to estimate a dynamic model of life satisfaction and overcome endogeneity issues (Powdthavee, 2009). Thus, we perform a two-step system[2] GMM developed by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). More specifically, the use of the GMM model allows us to control for three sources of endogeneity: simultaneity, unobserved heterogeneity, and dynamic endogeneity.[3] Our two-step system GMM model is presented in the following equation:

$$LS_{it} = \beta_1 LS_{it-1} + \beta_2 C_{it} + \beta_3 X_{it} + \lambda_t + \epsilon_{it} \tag{2}$$

[2]According to Arellano and Bover (1995) the two-step GMM model provides more efficient and consistent estimates in the case of panel data than the one-step GMM model. In order to determine whether we have to perform either a difference-GMM or a system-GMM model, we follow the second rule-of-thumb suggested by Blundell et al. (2001). Following these authors, the autoregressive model should be initially estimated using pooled OLS and a fixed-effects approach. The pooled OLS estimate for the parameter of the lag of the dependent variable should be considered as an upper-bound estimate while the one of the fixed-effects estimate is the lower-bound estimate. A difference-GMM estimate close or below the fixed-effects estimate suggests a downward bias and points us to the use of a system-GMM estimator. Results are detailed in Appendix, see Table B.2.1.

[3]Dynamic endogeneity bias arises due to the inclusion of the past realisation of the dependent variable.

where LS_{it-1} denotes the first lag of the dependent variable. The rest of the covariates are as given in equation (1). As suggested by Roodman (2009), we include time fixed-effects (λ_t) to avoid cross-individual correlation.

3 Data and summary statistics

3.1 Data

We use data taken from the Dutch Longitudinal Internet Studies for the Social Sciences (LISS) panel administered by CentERdata.[4] The LISS panel is a representative sample of Dutch individuals who participate in monthly Internet surveys. The panel is based on a true probability sample of households drawn from the population register, consisting of more than 4,500 households and over 7,000 individuals, and done in 137 monthly waves from November 2007 to March 2019. In the LISS survey, individuals report several aspects of their life, including their satisfaction with life, providing informal care and background information.[5] Our common sample is an unbalanced panel including 9,180 observations with 1,188 individuals observed over the period 2009-2018. 70 percent of those individuals are observed at least seven times.

Our dependent variable is an indicator of life satisfaction based on the question "How satisfied are you with the life you lead at the moment?". The respondent was asked to use an ordinal scale from zero (not all satisfied) to ten (completely satisfied). This single-item scale life satisfaction question is a widely used measure of subjective well-being. It has the advantage of asking the respondent to focus on an overall evaluation of their life rather than on current feelings or specific psychosomatic symptoms. According to Veenhoven (2000) and Frey and Stutzer (2002), life satisfaction is closely related to a number of other potentially more objective measures of happiness.

The variable of interest is whether or not the respondent has provided any kind of caregiving in the last twelve months. Informal care may be provided to a partner, family member, young person, acquaintance, friend, colleague or neighbor. Three types of care are considered: housekeeping help, e.g. cleaning, laundry, grocery shopping; personal care, e.g. bathing, showering, dressing; and personal support, e.g. arranging affairs, offering solace, listening. Due to the small number of observations in each category, we do not restrict our analysis to a specific relationship between the caregiver and the recipient. Instead, we take into account care provided to partners, children,[6] parents,[7] siblings, grand parents, other family members, friend, colleagues from work, or neighbors (non-family). Since receiving informal care implies being in poor health, it directly impacts one's life evaluation. Thus, we restrict our sample to respondents who did not themselves receive any kind of informal care.

[4] Tilburg University, The Netherlands. See for details: www.lissdata.nl

[5] Our panel is extracted from the LISS database and uses information from five panels of the core study: "Personality Questionnaire, LISS Core Study", "Family and Household Questionnaire, LISS Core Study", "Health Questionnaire, LISS Core Study", "Work and Schooling Questionnaire, LISS Core Study", "Social Integration and Leisure, LISS Core Study". For more details on our merge, see Appendix, Table A.1.1

[6] Including children adopted, step and foster.

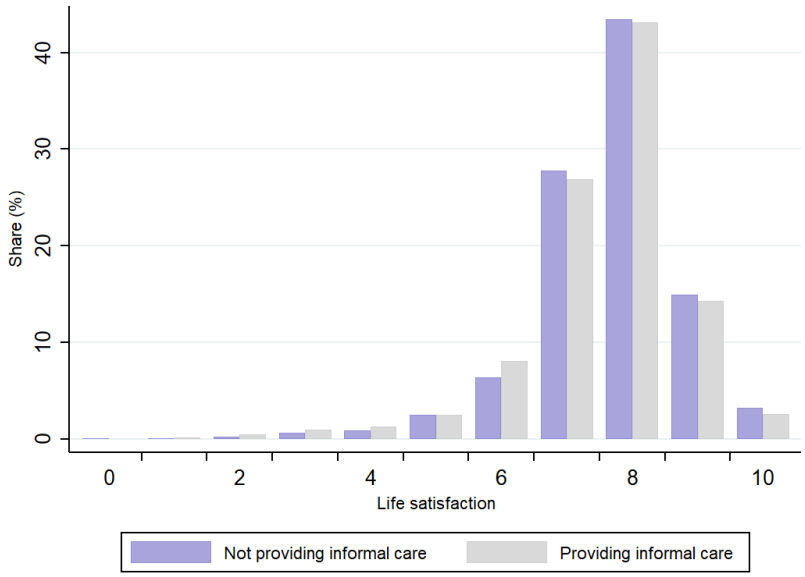
[7] Including step parents, parents in-law and foster parents.

Explanatory variables include age category, objective health, marital status, educational level, labour force status, children, working hours, log of standardized net household income, living environment and year dummies.[8]

3.2 Descriptive statistics

The distribution of life satisfaction by informal care provision is illustrated in Figure 1. The grade attributed to satisfaction with life for informal caregivers and non-caregivers follows a normal distribution centered around eight, which is standard in the literature. At a first glance, this figure indicates that satisfied people do not care for their relatives more than less satisfied people. The share of individuals providing care with a given life satisfaction level is roughly the same than the one for non-caregivers. Thus, based on descriptive statistics, it appears that life satisfaction does not play a role in the selection into caregiving.

Figure 1: Distribution of life satisfaction by informal care provision



Descriptive statistics are based on our common sample from LISS panel data (2009-2018) including 1,188 individuals and 9,180 observations.

We provide an overview of respondents' sociodemographic characteristics in Table 1. A high proportion of our common sample, about 24 percent of the observations, concerns individuals providing care. Comparing the raw percentages from the first column of Table 1 we see that the probability that a woman in this sample has provided informal care is higher than the probability that a man in this sample has provided informal care. Additionally,

[8]The definitions and descriptive statistics of the relevant variables are provided in Tables A.2.1 and A.2.2 in Appendix A.2.

we observe that the probability of providing care in this sample is higher for specific subgroups such as individuals aged over 55 years, individuals in co-habitation without children, and individuals working between zero and eleven hours per week. Moreover, non-caregivers have similar sociodemographic characteristics to caregivers, except with regard to gender, age categories, labour force status and weekly working hours. Although we do not have the information to draw this inference for the entire population, we performed a Pearson chi-squared test for each subgroup to test the independence between sociodemographic variables and informal care provision. The result of this test soundly rejects the null hypothesis of independence. Thus, the decision to become a career will be related to these factors, namely gender, age categories, labour force status and weekly working hours. We address the issue of confounding related to selection into caregiving in Section five, on robustness tests.

Table 1: Descriptive statistics of respondent sociodemographic characteristics

	Providing Informal Care (%)	Not providing Informal Care (%)
Gender		
Men	42	57
Women	58	43
Age		
15 - 24 years	1	3
25 - 34 years	1	6
35 - 44 years	4	14
45 - 54 years	21	20
55 - 64 years	33	25
65 years and older	40	32
Objective health		
Disease	37	30
No disease	63	70
Marital status		
Single	13	17
(Un)married co-habitation without children	56	48
(Un)married co-habitation with children	25	30
Single with children	4	4
Other	2	1
Standardized net monthly household income		
0€ - 1,350€	23	22
1,351€ - 1,800€	25	29
1,801€ - 2,300€	24	24
2,300€ and more	28	26
Occupation status		
Employed or self-employed	39	53
Unemployed	2	2
Out of the labour force	59	45
Education level		
Primary school	4	4
Intermediate Secondary Education	30	27
Higher Secondary Education	9	9
Intermediate Vocational Education	22	26
Higher Vocational Education	23	25
University	8	7
Other	4	2
Weekly Working hours		
0 - 11 Hours	58	42
12 - 21 Hours	9	8
22 - 33 Hours	15	15
34 - 39 Hours	11	17
More than 40 Hours	7	17
Living environment		
Rural	45	35
Moderately Urban	20	24
Urban	35	41
Number children at home		
None	72	66
One child	10	11
Two children	12	17
Three children	5	5
Four children and more	1	1
Observations	2,253	6,927

Descriptive statistics are based on our common sample from LISS panel data (2009-2018) including 9,180 observations and 1,188 individuals. We performed a Pearson's chi-squared test at a rejection rate of five percent.

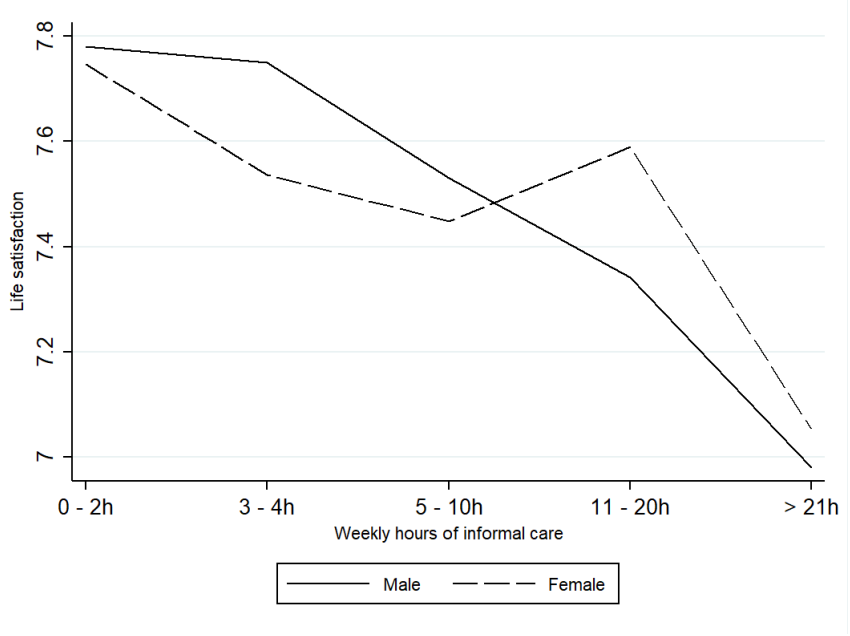
To provide a closer analysis of our sample, and more precisely of the potential caregivers, we present the characteristics of informal care in Table 2. We observe that respondents provide care mainly at a low frequency; 54% of caregivers help someone less than four hours per week. The type of informal care provided is mostly housekeeping and personal support; only 20% of caregivers provide personal care, e.g. bathing, showering, dressing. Finally, the care recipients are most often family members not living with the caregivers.

Table 2: Descriptive statistics of caregivers

	Providing Informal Care (%)	Observations
Weekly Hours of Informal Care		
Less than two hours	31	711
two - four hours	23	512
five - ten hours	26	583
11 - 20 hours	11	248
More than 20 hours	9	199
Kind of care provided		
Housekeeping	60	1,347
Personal care	20	450
Personal support	85	1,907
Residence of the care recipient		
Partner	17	377
Living at home	4	97
Not-living at home	79	1,779
Relation with the care recipient		
Partner	17	377
Family	58	1,319
Friends or colleagues	25	557

Descriptive statistics are based on our common sample from LISS panel data.
It includes 638 individuals and 2,253 observations.

Figure 2: Life satisfaction and frequency of care provision averages by gender



Descriptive statistics are based on our common sample from LISS panel data (2009-2018) restricted to individuals that help, including 638 individuals and 2,253 observations.

In Figure 2 we set out the average life satisfaction of informal caregivers depending on the intensive margin and on gender reported. We observe that average life satisfaction of men caregivers is constantly decreasing with an increasing number of weekly informal care

hours. Women's average life satisfaction follows a different pattern. For between zero and four hours of informal care per week their life satisfaction steadily decreases from 7.8 to 7.4 out of ten, while it goes up slightly, to 7.6, when women provide between ten and twenty hours of informal care per week. Overall, helping others more than twenty hours a week decreases the average life satisfaction of both men and women to around 7 out of 10.

4 Empirical Results

4.1 Baseline estimates

The results for both the OLS with fixed-effect approach and the GMM-system estimator are given in Table 3. The dependent variable is the respondent's life satisfaction measured on a scale rated from 0 to 10; for comparison, we also show the results from the OLS estimator with pooled data and clustered standard errors at the individual level to account for the dependency of the observations.

The OLS results are presented in the first two columns of Table 3.[9] To avoid dynamic endogeneity bias, we do not include the past realizations of the dependent variable in these specifications. As anticipated, the informal care decision is negatively correlated with the respondent's life satisfaction, meaning that being a caregiver leads to lower satisfaction (Models (1) and (2) of Table 3). In other terms, providing care reduces the life satisfaction of the caregiver by 0.07 points on a scale scored from 0 to 10. It is worth noting that the magnitude of the informal care coefficient changes when using pooled data (Model (1) of Table 3) compared with the fixed-effect specification ($0.121 > 0.07$). This difference might be explained by the fixed unobserved heterogeneity, correlated with both the dependent variable and at least one individual regressor. The impact of giving informal care on life satisfaction decreases by 0.051 points when we account for constant unobserved characteristics such as the respondents' personality traits.

We suspect our estimates to be biased due both to the simultaneity between the informal care provision and to life satisfaction. In order to verify whether our model suffers from the simultaneity bias, and thus would produce biased estimates, we performed several regressions to determine the impact of life satisfaction, including its lags, on the informal care decision. The results indicate that the decision to care depends significantly on the life satisfaction level and its past realizations. Consequently, we reject the strict exogeneity hypothesis of the decision to care.[10]

The lack of information on the health status of the care recipient might also bias our results by overestimating the *caregiving effect*. In order to identify whether our model suffers from the omitted variable bias related to the information on the care recipient, we performed a Durbin-Wu-Hausman test. This method consists in the inclusion of the residuals of the endogenous variable as a function of the exogenous variable in our main specification (for more details, see Davidson & Mackinnon, 1992; Ullah et al., 2018). Unlike the simple OLS

[9] Full estimates are in the Appendix, see Table C.1.1.
[10] Results are in the Appendix, see Table B.3.1.

Table 3: OLS and two-step system GMM estimates of life satisfaction

	Pooled OLS	OLS with fixed-effects	Two-step system GMM, instrument from second lag to third lag dependent variable	Two-step system GMM, instrument from third lag to fourth lag dependent variable
	Model (1)	Model (2)	Model (3)	Model (4)
l. Life satisfaction	-	-	0.088***	0.066***
			(0.01)	(0.01)
Informal	-0.121***	-0.070**	-0.087***	-0.086***
	(0.05)	(0.03)	(0.02)	(0.02)
Constant	5.425***	7.485***	7.309***	7.484***
	(0.44)	(0.46)	(0.23)	(0.20)
Number of observations	9180	9180	9180	9180
Number of groups	1188	1188	1188	1188
Time fixed-effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
R-squared	0.10	0.02		
Number of instruments			474	470
AR(1)			0.000	0.000
AR(2)			0.067	0.131
Hansen test			0.777	0.508

In the first column standard errors are clustered at the individual level. * p<0.10, ** p<0.05, *** p<0.010
In models (3) and (4), all explanatory variables –except for time dummies, gender and age categories –are treated as endogenous.
We instrument the lag of the life satisfaction with its first and second lags in Model (3).
We instrument the lag of the life satisfaction with its second and third lags in Model (4).
We instrument other endogenous regressors with their first and second lags.

with fixed-effects model that fails to control for varying omitted variables, the Durbin-Wu-Hausman test determines whether varying information contained in the residuals is correlated with individual regressors. A significant t-test of the Durbin-Wu-Hausman test means that the information contained in the error term is likely to be correlated with the dependent variable. Thus, the results of this test, displayed in Table 4, lead to the rejection of the null hypothesis of exogeneity and allow us to conclude that the OLS estimator is inconsistent.[11]

Table 4: The augmented regression test (Durbin-Wu-Hausman)

	Pooled OLS	OLS with fixed-effects
	The informal care decision	Life satisfaction
Informal	-	4.903*
		(2.83)
Residuals	-	-4.972*
		(2.83)
Constant	-0.051	6.955***
	(0.13)	(0.57)
Observations	9180	9180
Number of groups	1188	1188
Time fixed-effects	Yes	Yes
Controls	Yes	Yes
Residuals test Prob > chi2 = 0.079		

Standard errors are in parenthesis. In the first column, standard errors are clustered at the individual level.* p<0.10, ** p<0.05, *** p<0.010

We apply a panel-based GMM-system estimator to address the endogeneity of the informal care decision. Model (3) of Table 3 introduces the first lag of the life satisfaction as a right-hand side variable. In Model (3), we use the two most recent lags of the dependent variable as instruments to control for dynamic endogeneity due to the inclusion of the past realization of life satisfaction. All the other endogenous regressors[12] are instrumentalized by their first and second lags. The estimated coefficient of the lagged life satisfaction is positive and highly

[11] Detailed results of the Durbin-Wu-Hausman test are given in the Appendix, see Table B.3.2.
[12] All explanatory regressors, except time dummies, gender and age categories, are treated as endogenous.

significant, which is in line with hedonic capital theory, i.e., that happiness today relies on past happiness (Graham & Oswald, 2010). The GMM estimator generated a coefficient on informal care provision that is significant, negative and slightly larger than the one estimated using OLS fixed-effects.

Nevertheless, two problems arise when using the GMM estimator. The first one concerns the proliferation of instruments that may overfit endogenous variables (Roodman, 2009). Since there is no clear consensus on "how many is too many" instruments (see Ruud, 2000; Windmeijer, 2005; Roodman, 2009), we follow the arbitrary rule-of-thumb mentioned by Roodman (2009) that instruments should not outnumber individual units.[13] The results of Model (3) respect this rule as the number of instruments does not exceed the number of individuals ($474 < 1188$). Our results also pass the Hansen test of over-identifying restrictions in Model (3) with a high p-value of 0.777, well above the significance level of 0.1.

The second matter of concern is serial autocorrelation, meaning that error terms might be correlated. In order to overcome this issue, we perform a first and a second order serial correlation test to examine whether the differenced error term was first –or second –order serially correlated. Specification of Model (3) is rejected by the test of serial correlation, which is significant in both levels. These results mean that the past realizations of life satisfaction, respectively second lag and third lag, are not valid instruments, due to the correlation with the error term. While a significant first-order serial correlation is to be expected, the second-order correlation is a matter of concern since it detects autocorrelation in levels and might signal that instruments are misspecified.

To tackle this issue, we perform a fourth model (Model (4) in Table 3) that excludes the most recent lags of life satisfaction. We rely on the hypothesis that serial autocorrelation would decrease with older realizations of life satisfaction. Instead, we use the third and fourth lag of the dependent variable in Model (4) of Table 3. Other endogenous regressors are still instrumentalized with their first and second lags. This new specification is supported by the second-order serial correlation, which becomes insignificant. Changing the list of instruments does not alter the results of the informal care provision and the lag of the dependent variable, the coefficient magnitude of which has slightly decreased from 0.09 to 0.07. This last model also respects the rule about the proliferation of instruments ($470 < 1188$).

4.2 Heterogeneity analysis

In this subsection, we explore how the impact of informal care provision on life satisfaction may vary depending on care specificities. First, we examine whether the impact of the informal care provision differs in various subsamples. Secondly, we discuss how the frequency of informal care provided, the kind of care, and the relationship with the care recipient, may mitigate the effect of informal care provision on caregivers' life satisfaction.

[13] We address the sensitivity of our results to the number of instruments in Section 4.

4.2.1 Sociodemographic characteristics

The literature points out the prevalence of gender in explanations of the decision to care. Thus, women are more often involved in the care provision, either formal (Bonnet et al., 2011) or informal (Billaud & Gramain, 2014; Norton, 2000) compared to men. The high proportion of women in the caregiver population might be explained not only by their lower opportunity cost, compared with men, on the labour force force market (Carmichael & Charles, 2003), but also by the gender norms to which they are assigned (Membrado, 2013). Consequently, women are more likely to face adverse effects on mental health (Pinquart & Sörensen, 2007). Based on the literature, we conduct detailed analysis of the role of gender in the explanation of informal care provision. Results are displayed in Model (1) and Model (2) of Table 5. Both males and females are negatively impacted by the provision of informal care, however, females tend to suffer more in terms of life satisfaction lost. This result is in line with the literature on informal care and health (Kenny et al., 2014). It is also worth noting that female current life satisfaction depends negatively on their past. However, results of Model (1) are not totally reliable as it suffers from remaining serial correlation in levels.

In addition, a number of articles have also dealt with the role of labour force status on the decision to provide care, with mixed findings (Ettner, 1996). These heterogeneous results are probably due to the difficulty in disentangling the simultaneity between the informal care decision and labour force status. We estimate the effect of providing informal care on life satisfaction by labour force status. Results are presented in Models (3), (4) and (5) of Table 5. Providing informal care has a negative impact on life satisfaction, for both employed and self-employed respondents, with a lower life satisfaction of about 0.19 points when they provided informal care. Caregiving may imply opportunity costs related to the time spent in paid employment and may have adverse effects on a caregiver's wage and career (Bauer & Sousa-Poza, 2015). Surprisingly, unemployed individuals are even more affected by caregiving than employed or self-employed with a coefficient of 0.37. However, the specification of Model (4) is not consistent with the rule-of-thumb from Roodman (2009), as the instruments outnumber the individuals units.

Another sociodemographic characteristic that seems to play a role in the relationship between informal care and life satisfaction is marital status. Bom et al. (2019) show that married caregiver females are even more at risk than non-married caregiver females. On the contrary, Niimi (2016) finds a negative impact of informal care provision on the happiness level of unmarried caregivers, highlighting the lack of clear consensus on the role that the marital status might play. Estimates of Models (6), (7), (8) and (9) displayed in Table 5 show the effect of providing informal care on life satisfaction by marital status. Overall, being a caregiver has a negative impact on life satisfaction, except for single respondents with children. On average, married respondents cohabiting with children grade their life satisfaction 0.24 points lower than caregivers. Parents have to care for their children besides their duties as informal caregivers. Thus, their time constraints are higher compared to individuals without children. This result is consistent with the findings of Bom et al. (2019) showing that the negative health effect of caregiving is larger for married individuals with children. Moreover, Models (6) and (8) suffer from the proliferation of instruments (a Hansen p-value of 1.00 is a sign of trouble).

Table 5: Heterogeneity analysis - Informal care provision and sociodemographic characteristics

	Two-step system GMM estimates on life satisfaction				
	Model (1) Male	Model (2) Female	Model (3) Employed or self-employed	Model (4) Unemployed	Model (5) Out of the labor force
l. Life satisfaction	0.131***	-0.063***	0.072***	-0.019	-0.039***
	(0.01)	(0.01)	(0.01)	(0.04)	(0.01)
Informal	-0.041*	-0.141***	-0.190***	-0.370**	-0.049**
	(0.02)	(0.02)	(0.03)	(0.15)	(0.02)
Constant	6.533***	8.292***	7.334***		7.650***
	(0.18)	(0.16)	(0.43)		(0.28)
Observations	4916	4264	4555	177	4448
Number of groups	622	566	709	115	695
Time fixed-effects	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Number of instruments	445	439	413	192	381
AR(1)	0.00	0.00	0.00	0.00	0.00
AR(2)	0.06	0.83	0.24	0.56	0.77
Hansen test	0.94	0.91	0.89	1.00	0.96

	Model (6) Single	Model (7) Married without children	Model (8) Married with children	Model (8) Single with children
l.Life satisfaction	0.138***	0.066***	0.039***	-0.061
	(0.01)	(0.02)	(0.01)	(0.06)
Informal	-0.055***	-0.077***	-0.242***	0.444**
	(0.02)	(0.02)	(0.03)	(0.19)
Constant	4.955***			9.346***
	(0.16)			(2.41)
Observations	1469	4620	2606	357
Number of groups	240	686	418	79
Time fixed-effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Number of instruments	332	346	320	247
AR(1)	0.00	0.00	0.00	0.00
AR(2)	0.30	0.58	0.10	0.71
Hansen test	1.00	0.66	0.75	1.00

Standard errors are in parenthesis. * p<0.10, ** p<0.05, *** p<0.010

All explanatory variables –except for time dummies, gender and age categories –are treated as endogenous.

As in the main specification, we instrument the lag of the life satisfaction with its second and third lags in all these models.

As in the main specification, we instrument other endogenous regressors with their first and second lags in all these models.

Detailed results are available upon request.

4.2.2 Specificity of care provided

The focus of all models presented in this subsection is on individuals that have provided care at least once, meaning that non-caregivers are excluded. Our estimations are based on a restricted sample of 638 individuals and 2,253 observations. The estimated coefficient of our two-step system GMM model looking at the residence of the care recipient is shown in Model (1) of Table 6. We split our common sample of informal caregivers into three categories, namely: caregivers of someone living in the same household, caregivers of someone

living outside the household, and caregivers for a partner. We choose to create this specific category since correlates on informal care highlight that spouse caregivers have to carry a higher care burden than child caregivers (Llacer et al., 2002). Taking care of someone living in the same household reduces life satisfaction by 0.22 points, on average, compared with caring for someone not living at home. We do not find a significant difference between caring for someone not living at home and caring for partners. This result is in line with those of Kramer (1997) and García-Castro et al. (2019).

Additionally, in Model (2) of Table 6 we split the common sample of informal caregivers into three categories depending on their relationship with the care recipient. We find that taking care of a family member or a partner has a significant negative impact on life satisfaction compared with caring for a friend or a neighbor, such that, on average, family caregivers grade their life satisfaction 0.14 points lower than those taking care of a friend, colleague or neighbor.

We then look at the kind of care provided, i.e., housekeeping, personal care and personal support, as shown in Models (3), (4) and (5) of Table 6. Overall, we find that all these types of care had a negative impact on life satisfaction, although the magnitude of the estimated coefficient is higher when providing housekeeping and personal care than for personal support. Helping someone do house chores and personal care respectively reduces life satisfaction by 0.22 points and 0.26 points while providing personal support only decreases life satisfaction 0.13 points. Intuitively this result is expected, since housekeeping and personal care may be considered to be more burdensome and physically demanding than personal support.

The estimated effects of informal care weekly hours on the life satisfaction of caregivers are presented in Model (6) of Table 6. The higher the weekly hours of care, the lower respondents grade their satisfaction with life. In this estimation, the reference category is "providing informal care between 5 and 10 hours a week". We observe that providing informal care for less than 4 hours a week has a positive impact on life satisfaction compared with the reference category. In contrast, helping more than 11 hours a week has a negative impact on caregivers' life evaluation compared to a lower care intensity. The difference is particularly pronounced for carers helping more than 20 hours a week. On average, they grade their life satisfaction 0.22 points lower than those who provide care between 5 and 10 hours a week. Similar results are found in the literature on informal care and health (Pinquart & Sörensen, 2007).

Overall, it is worth noting that, for all of the six specifications, the Hansen test and the second-order serial correlation test do not reject the null hypothesis of exogeneity. Moreover, the number of instruments never exceeds the number of individual units.

Table 6: Heterogeneity analysis - Informal care specificities

	Two-step system GMM estimates on life satisfaction					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Residence of the care recipient. Ref: Not living at home						
Living at home	-0.225***					
	(0.02)					
Partner	0.006					
	(0.03)					
Difference in subgroups						
Living at home = Partner	***					
Relationship with the care recipient. Ref: Broader relative						
Family member		-0.137***				
		(0.02)				
Partner		-0.075**				
		(0.03)				
Difference in subgroups						
Family member=Partner		**				
Type of care provided						
Housekeeping			-0.220***			
			(0.01)			
Personal care				-0.260***		
				(0.02)		
Personal support					-0.127***	
					(0.03)	
Weekly hours of care. Ref: Between 5 and 10 hours						
Less than 2 hours						0.094***
						(0.01)
From 2 to 4 hours						0.087***
						(0.01)
From 11 to 20 hours						-0.033**
						(0.02)
More than 20 hours						-0.226***
						(0.02)
Constant	6.760***	7.617***	0.000	0.000	7.966***	7.394***
	(0.25)	(0.32)	(.)	(.)	(0.37)	(0.28)
Number of observations	2253	2253	2253	2253	2253	2253
Number of groups	638	638	638	638	638	638
Time fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Number of instruments	383	383	3628	362	362	425
AR(1)	0.00	0.00	0.00	0.00	0.00	0.00
AR(2)	0.38	0.57	0.69	0.65	0.59	0.45
Hansen test	0.87	0.85	0.89	0.99	0.92	0.91

Standard errors are in parenthesis. * p<0.10, ** p<0.05, *** p<0.010

All explanatory variables –except for time dummies, gender and age categories –are treated as endogenous.

As in the main specification, we instrument the lag of the life satisfaction with its second and third lags in all these models.

As in the main specification, we instrument other endogenous regressors with their first and second lags in all these models.

Detailed results are available upon request.

5 Robustness Tests

In order to test the reliability of our results, we perform a series of robustness tests using alternative specifications. First, we examine the selection of caregivers in life satisfaction. We also check whether choosing a different definition of the dependent variable is likely to affect our results. Then, we analyse the sensitivity of our results to the number of lags, and consequently to the number of instruments. Finally, as GMM estimators do allow the use of external instruments, we include macroeconomic instruments.

5.1 Sensitivity analysis: Selection bias and propensity score matching

In this subsection, we investigate whether the observed effect of informal caregiving on life satisfaction might result from the self-selection of individuals into the provision of informal care. In other words, can specific personal characteristics predispose individuals to self-selection into informal care provision. More precisely, the "selection in" caregiving refers to people deciding to become caregiver (Do et al., 2015). We know from the literature that the individuals who become caregivers and keep on providing support over years are more often women, poorer and have lower opportunity costs (for a review, see Bauer & Sousa-Poza, 2015). How would we interpret our results if it transpires that it is dissatisfied and underemployed older women without children who provide the bulk of informal care? Under these conditions, the level of life satisfaction that underemployed older women without children and working few hours would have reported if they had not provided informal care remains unclear. Another criteria inducing self-selection into caregiving might be mental health (Coe & Van Houtven, 2009). We might reasonably wonder whether health status might determine who will provide care inside a family (Schulz et al., 1990). Is the most unhealthy child, compared with her siblings, less likely to care for her parents? Thereupon, the selection of caregivers with respect to health is increasing with age, as health deteriorates over time (Easterlin, 2003), meaning that age is also a determinant of the selection into caregiving duties. On top of that, we might wonder how life satisfaction, which is worsening with the decline in health, impacts selection into caregiving. For instance, we might worry that the people who are least satisfied with their life have lower propensities to become caregivers, or that individuals need a given degree of satisfaction with their own life before diving into caregiving activities (Coe & Van Houtven, 2009). In other words, we want to compare individuals, including caregivers and non-caregivers, who had the same life satisfaction baseline before caregiving.

Propensity score matching reduces this selection bias by comparing the happiness of informal caregivers to that of non-caregivers (Rosenbaum & Rubin, 1983; Caliendo & Kopeinig, 2008) who are as similar as possible in all other respects. This methodology has recently been applied in other happiness studies (Binder & Coad, 2013; Nikolova & Graham, 2014; Tiefenbach & Kohlbacher, 2015; Hessels et al., 2018; Arampatzi et al., 2018). This statistical technique can be compared to a randomized control trial in which two groups of individuals are randomly assigned to the treatment under study or to a control group.

In our case, the treatement is the informal care provision. The effect of the treatment

is referred as the Average Treatment effect (ATE), and in our case it can be defined as the difference between informal caregivers and non-informal caregivers as regards their expected life satisfaction. For the purpose of our present research, we use the nearest-neighbour matching estimator, which is often used in propensity score matching (Becker & Ichino, 2002). We chose this matching estimator because we have many comparable untreated respondents in our sample (Caliendo & Kopeinig, 2008), that is to say, many respondents that do not provide care. We create a new subsample including respondents that have not helped in 2009 only (first wave of our sample) to apply the nearest-neighbor matching method, of which the minimum matching request is 1. We have excluded those who have helped in the first wave because we have no information on their past levels of life satisfaction (before 2009). From 2010, respondents are matched on the following characteristics: gender, age category, lag of life satisfaction, objective health, marital status, occupational status, household income and weekly working hours. We also correct for a large-sample bias that exists when matching on more than one continuous covariate.

We draw three specifications, displayed in Table 7. The first one shows the difference between the treated and the untreated in 2010 given that none of them had helped in 2009. The lack of significance of the difference means that there is no clear effect of the treatment, however this is probably due to the small sample size. For the second and third specifications, respectively from 2010 to 2012 and for the total sample, we include time fixed-effects allowing us to match individuals with similar characteristics within a year. Based on our estimation for the total sample, we find that individuals providing informal care and having similar characteristics, namely the same life satisfaction level before the treatment, are significantly less satisfied with their life than non-caregivers. Overall, consistent with our findings from the two-step system GMM estimator, there is a significant negative difference in life satisfaction between the treated and the untreated, leading us to conclude that self-selection bias is not an issue.

Table 7: Average Treatment Effect: Nearest-Neighbor Matching method

	Differences between treated and untreated		
	In 2009	From 2009 to 2012	Total sample
Average Treatment Effect			
Informal	-0.099	-0.239**	-0.101**
	(0.14)	(0.11)	(0.05)
Observations	744	1476	6364
Time effects	No	Yes	Yes

Standard errors are in parenthesis. * p<0.10, ** p<0.05, *** p<0.010
The minimum matching request is 1.
Individuals are matched on gender, age category, lag of life satisfaction, objective health, marital status, occupational status, household income and weekly working hours.

5.2 Alternative definitions and specifications

This robustness test deals with the sensitivity of our results to the definition of subjective well-being. Initially, we analysed the causal relationship between caregiver's life satisfaction and informal care provision. We now use the caregiver's happiness level as the dependent variable. More precisely, respondents answered the following question "On the whole, how happy would you say you are?"; the rating scale is from zero, totally unhappy, to ten, totally happy. A first difference between the life satisfaction question and the happiness question concerned the time period evaluated, since the former question refers to an evaluation of the current life the individual is leading, while the latter asks the respondent to evaluate their life in general. Additionally, the question on life satisfaction involves cognitive appraisals based on aspirations, expectations and values, while the question on happiness is more reliant on the sensory system (Veenhoven, 2000). The results are displayed in Model (1) of Table 8.[14] Informal care provision leads to lower happiness levels, reducing it by 0.12 points. Although the overall negative result does not change, the coefficient magnitude increases from 0.09 points using life satisfaction to 0.12 points using the happiness score.

In the paper thus far we have considered the extensive margin of informal care provision. We now turn to look at the intensive margin, defined as the number of hours of care provided within a week. Although the result displayed in Model (2) of Table 8 shows a negative and significant effect of the intensive margin on life satisfaction, it is noteworthy that the second-order serial correlation test is significant, rejecting the null hypothesis of exogeneity.

The results of the previous section highlight the importance of the number of lags as instruments and how they might be sensitive to it. We initially used instruments from the second to the third lag of the lagged dependent variable and instruments from the first lag to the second lag for other endogenous regressors. For our robustness tests we implement instruments from the second to the third lag (Model (3) of Table 8), and from the third to the fourth lag (Model (4) of Table 8)[15] for other endogenous regressors. There are two reasons

[14]Full estimates are given in the Appendix, see Table C.1.2.
[15]Full estimates are given in Appendix, see Table C.1.2.

for choosing these lags. First, dropping the most recent lags might avoid any remaining serial correlation, as seen in the main specification displayed in Table 3. Secondly, limiting the number of lags allows us to respect the rule-of-thumb mentioned by Roodman (2009) that instruments should not outnumber the number of individuals units, as is the case in Table 5. In these two models, the number of instruments is well under the number of individuals. The overall negative relationship between the care provided and life satisfaction levels remains quite stable. Moreover, the second-order correlation test and the Hansen test of overidentification are well above the upper significance level of 0.1, meaning that our estimates are correctly specified. We find that the negative and significant relationship between providing informal care and life satisfaction holds regardless of the number of lags used. Note, however, that the size of the estimated negative coefficient was slightly higher, about -0.15, when we used the second and third lags of the endogenous regressors.

Table 8: Alternative specifications

	Two-step system GMM estimates on life satisfaction/life happiness				
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
l. Happiness	0.032***				
	(0.01)				
l. Life satisfaction		0.086***	-0.003	-0.058***	0.034***
		(0.01)	(0.01)	(0.02)	(0.01)
Informal	-0.117***		-0.152***	-0.170***	-0.082***
	(0.02)		(0.05)	(0.04)	(0.03)
Frequency		-0.006***			
		(0.00)			
Constant	7.798***	7.451***	6.768***	7.281***	7.857***
	(0.19)	(0.19)	(0.31)	(0.36)	(0.24)
Observations	9013	9180	9180	9180	7196
Number of groups	1188	1188	1188	1188	1176
Time fixed-effects	Yes	Yes	Yes	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes
Number of instruments	469	470	408	382	426
AR(1)	0.000	0.000	0.000	0.000	0.000
AR(2)	0.208	0.075	0.535	0.664	0.283
Hansen test	0.304	0.603	0.125	0.512	0.492

Standard errors are in parenthesis. * p<0.10, ** p<0.05, *** p<0.010
All explanatory variables –except for time dummies, gender and age categories –are treated as endogenous.
In all models, we instrument the lag of the life satisfaction with its second and third lags.
We instrument other endogenous regressors with their first and second lags in Model (1), (2) and Model (5).
We instrument other endogenous regressors with their second and third lags in Model (3).
We instrument other endogenous regressors with their third and fourth lags in Model (4).

5.3 Long-term care reform in the Netherlands (2015)

In this paper we have presented an analysis of the causal relationship between informal care provision and caregivers' life satisfaction using internal instruments only. As mentioned previously, the Dutch government undertook major reforms of the Dutch long-term care system in 2007 and 2015, with the most important set of measures being set in place in 2015. The

Dutch government had three main goals with these reforms: saving costs, keeping people self-sufficient for as long as possible, and improving quality and coordination of care using a client-tailored approach (Maarse & Jeurissen, 2016). A key element of the reform laws is that social care, e.g home help, transport facilities and home adjustments, is decentralized to municipalities under the Social Support Act (Wet Maatschappelijke Ondersteuning, WMO). The Social Support Act was revised to strengthen the role of people's social networks in providing care. Each municipality is free to organize non-residential care and its need-assessment procedures as it sees fit, while at the same time the government has encouraged family members and local community networks, i.e., neighborhood networks, to provide for various social care needs, e.g., through home help. All in all, successive reforms have been implemented by the Dutch government to shift the responsibility of care towards the family or local community, increasing the probability that Dutch citizens will need to provide informal care for relatives and others.

As GMM-estimators do allow the use of external instruments, we are interested in macroeconomic variables that are assumed to reflect the evolution of the long-term care system following the reforms in the Netherlands. We use data from the OECD database from 2009 to 2017, as information for 2018 was not yet available. More precisely, we focus on the number of long-term care workers at home and long-term care spending as a share of Gross Domestic Product (GDP). Following the Dutch reforms that are supposed to reduce the Dutch responsibility in long-term care services, the number of long-term care workers and the share of long-term care spending in GDP are set to decrease. Assuming that informal care is an effective substitute for formal care, we would thus expect an increase of the informal care supply and thereby a strong negative impact of the Dutch reforms on caregivers' life satisfaction.

As these two external instruments do not vary between or within individuals, they were extremely collinear with the time dummies, which were finally excluded, as shown in Model (5) of Table 8.[16]

Overall, using external instruments does not change the negative impact the informal care provision has on caregivers' life satisfaction, and neither the second-order serial correlation nor the Hansen test rejected this specification. Moreover, the Difference-in-Hansen test for this subset of instruments does not reject the null hypothesis of exogeneity; however, the effect of these two external instruments might not be causal, as we have excluded the time dummies and are likely to pick up other effects of different variables that are constant across individuals.

[16]Full estimates are given in Appendix, see Table C.1.2.

6 Conclusion

Using 9 waves of the LISS data, we study the relationship between providing informal care and self-reported life satisfaction, accounting for the main sources of endogeneity.

We find evidence of a negative effect of caregiving on life satisfaction. Our results hold using different estimation methods and after dealing with several endogeneity issues that would have been likely to bias our results. We also provide heterogeneity and subgroup analyses, which indicate that intensive care provision exacerbates the negative effect of informal care on life satisfaction. Among caregivers, providing support to someone living in the same household or being a family caregiver, has a stronger negative impact on life satisfaction. Another important finding is that the detrimental effect of caregiving was larger for women, individuals cohabiting with children, and employed or self-employed individuals.

Our research is robust to a number of identification and methodological issues. More precisely, we show that our results are not sensitive to the use of alternative definitions and instruments. We also deal with the selection bias by estimating the difference in life satisfaction between caregivers and non-caregivers, all other things being equal.

This steady negative impact of providing care on a caregivers' life satisfaction, shown throughout our analysis, reveals how important is it to account for the indirect costs of caregiving. In this regard, the reforms that have been undertaken in the Netherlands in recent years may have underestimated the negative impact of care provision on the caregiver's subjective well-being. The Netherlands decentralized domiciliary care to municipalities in order to incentivise them to yield efficiency gains and to tailor provision to individual needs. At the same time, this might have induced an under-provision of municipal services, and substitution towards care provided by individual networks on a voluntary basis. Our results are in favor of public policies that help informal caregivers deal with the responsibilities being placed on them, such as extending psychological support and providing social support in cash or in kind.

The main limitation of our work is an external validity issue. Since we focus on the case of the Netherlands, our results may not be generalizable. Indeed, the specific reforms implemented on long-term care, the work-arrangement offer to informal caregivers, and the particular motives of Dutch informal caregivers, may partly explain the negative impact of providing informal care on life satisfaction.

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APPENDICES

A Our data

A.1 Merge procedure

To run our analysis we combined different modules from the LISS panel data. The personality questionnaire from the LISS Core study contains information on subjective well-being, the questionnaire background incorporates sociodemographic information, the questionnaire on social integration and leisure includes information on informal care provisions, the questionnaire on work and schooling contains information on working time, and the questionnaire on health contains questions on objective health.

In order to ensure consistency in our merge we made sure that for each year the selected questionnaire was the closest of the month on which the questionnaire about personality was administered. We made this choice because life satisfaction was our main dependent variable.

Questions regarding respondents' background are asked almost every months. Thus, we selected background information that corresponded to the month where the personality questionnaire was administered. Concerning the questionnaire on social integration and leisure we chose to use the questionnaire administered in October and November 2016 for year 2017, because the question on life satisfaction was asked in May and June 2017. Thus, the questions on informal care were asked before the question on life satisfaction and with the same month gap.

We made the same choice in defining the year 2018. The maximum month gap between the personality questionnaire and the social integration and leisure questionnaire was in 2017 and 2018, at about 6 months. This month gap gave about 8 months between the questionnaire on personality and the questionnaire on work and schooling for years 2014 and 2015. For the health questionnaire the maximum month gap was one year in 2014, and as, no health questionnaire was administered in 2014, we decided to take health information from November and December 2013 for the year 2014. Regarding the other years the health questionnaire is done in November and December, thus for every year we took the lag of the health questionnaire. For instance, in year 2009 we used information from the health questionnaire conducted in November and December 2008. The personality questionnaire was not available for year 2016. As a consequence we missed year 2016 in our sample.

At the end of our merge procedure we ended up with a balanced panel of data including 9,180 observations for 1,188 individuals observed over nine years. Table A.1.1 sums up this merge procedure.

Table A.1.1: Merge procedure

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Personality	05-08/2008	05-06/2009	05-06/2010	05-06/2011	05-06/2012	05-06/2013	11-12/2014	11-12/2015	-	05-06/2017	05-06/2018
Background	07/2008	05/2009	05/2010	05/2011	05/2012	05/2013	12/2014	12/2015	-	05/2017	05/2018
Social integration and leisure	02-05/2008	02-03/2009	02-03/2010	02-03/2011	02-03/2012	02-03/2013	02-03/2014	10-11/2015	-	10-11/2016	10-11/2017
Work and schooling	04-05/2008	04-05/2009	04-05/2010	04-05/2011	04-05/2012	04-05/2013	04-05/2014	04-05/2015	-	05-06/2017	05-06/2018
Health	11/2007 and 02/2008	11-12/2008	11-12/2009	11-12/2010	11-12/2011	11-12/2012	11-12/2013	07-08/2015	-	11-12/2016	11-12/2017

A.2 Definitions of variables

Table A.2.1: Definitions of variables

Variable	**Definition**
Age category	0 "15-24 years" 1 "25-34 years" 2 "35-44 years" 3 "45-54 years" 4 "55-64 years" 5 "65 years and older"
Care recipient living at home	0 "The care recipient is not living in the same household" 1 "The care recipient is living in the same household" 2 "The care recipient is our partner"
Care recipient relationship	0 "The care recipient is a family member" 1 "The care recipient is a friend or colleague or neighbor" 2 "The care recipient is our partner"
Child(ren)	Number of living-at-home children in the household
Education level	From the lowest to the highest level of education with diploma (one to nine).
Gender	Dummy (=1) if the respondent is a woman
Happiness	Score on question "On the whole how happy would you say you are?" (zero to ten)"
Housekeeping help	Dummy variable if the caregiver helped the care recipient with cleaning, laundry, grocery shopping.
Informal care	Dummy variable (=1) if the individual regularly help someone requiring help due to a disease or other affliction over the past 12 months.
Labour force status	0 "Employed or self-employed" 1 "Unemployed" 2"Out of the labor force"
Life satisfaction	Score on question "How satisfied are you with the life you lead at the moment?" (zero to ten)
Living environment	From urban character of place of residence to rural (one to five)
Log of standardized net household income	Log of the net monthly household income divided by the square root of household members
Marital status	0 "Single" 1 "(Un)married co-habitation, without child" 2 "(Un)married co-habitation, with child(ren)" 3 "Single, with child(ren)" 4 "Others"
Objective Health	Dummy variable (=1) if suffer from any kind of long-standing disease
Personal care	Dummy variable if the caregiver helped the care recipient with bathing, showering, dressing.
Personal support	Dummy variable if the caregiver helped the care recipient with arranging affairs, offering solace, listening.
Work hours	Weekly working hours according to employment contract.
Year	Year dummies (2009-2018), reference year is 2009

Table A.2.2: Descriptive statistics

Variables	**Mean**	**Standard deviation**	**Min**	**Max**	**Observations**
Life satisfaction	7.6	1.2	0	10	9,180
Happiness	7.7	1.1	1	10	9,092
Informal care frequency	9.2	16.8	0	168	2,253
Age	57.1	13.7	17	96	9,180
Child(ren)	0.6	1.0	0	6	9,180
Work hours	17.6	17.1	0	68	9,180

Descriptive statistics based on our common sample. It includes 9,180 observations and 1,188 individuals.

B Empirical tools

B.1 Fixed-effects vs Random effects

Table B.1.1: Hausman test

	OLS estimates	
	Fixed-effects	Random effects
Informal	-0.070***	-0.082***
	(0.03)	(0.03)
Gender	-	-0.014
		(0.06)
Age categories. Ref: 15-24		
25-34	0.234**	0.254***
	(0.10)	(0.09)
35-44	0.270**	0.197*
	(0.13)	(0.11)
45-54	0.232	0.175
	(0.15)	(0.11)
55-64	0.237	0.222**
	(0.16)	(0.11)
65 and over	0.137	0.136
	(0.17)	(0.12)
Objective health	0.121***	0.220***
	(0.04)	(0.03)
Marital status. Ref: Single		
Married without children	-0.035	0.309***
	(0.08)	(0.06)
Married with children	0.016	0.162**
	(0.10)	(0.08)
Single with children	0.052	-0.090
	(0.12)	(0.10)
Other	-0.277**	-0.023
	(0.13)	(0.11)
Educational status: Ref: Primary school		
Intermediate secondary education	-0.491***	-0.110
	(0.18)	(0.11)
Higher secondary education	-0.490**	-0.254**
	(0.20)	(0.12)
Intermediate vocational education	-0.567***	-0.203*
	(0.19)	(0.11)
Higher vocational education	-0.322	-0.026
	(0.21)	(0.12)
University	-0.389*	-0.052
	(0.23)	(0.13)
Others	-0.593***	-0.257*
	(0.21)	(0.15)
Not yet completed any education	-0.376	-0.100
	(0.28)	(0.25)
Not yet started any education	-1.356*	-0.853
	(0.81)	(0.80)
Labour force status. Ref: Employed or self-employed		
Unemployed	-0.276***	-0.306***
	(0.07)	(0.07)
Out of the labor force	0.203***	0.209***
	(0.05)	(0.04)
Children	-0.151***	-0.042
	(0.04)	(0.03)
Working hours	-0.002*	-0.002
	(0.00)	(0.00)
Household income	0.019	0.057***
	(0.02)	(0.02)
Living environment. Ref: Extremely urban		
Very urban	-0.198	-0.120
	(0.14)	(0.08)
Moderately urban	0.187	0.066
	(0.16)	(0.09)
Slightly urban	0.128	0.081
	(0.16)	(0.09)
Not urban	-0.019	0.108
	(0.18)	(0.09)
Constant	7.485***	-
	(0.33)	
Observations	9180	9180
Time fixed-effects	Yes	Yes
Hausman test Prob > chi2 = 0.000		

Standard errors are in parenthesis. * p<0.10, ** p<0.05, *** p<0.010. The sample includes 1188 individuals.

B.2 Difference GMM vs System GMM estimator

Table B.2.1: Rule-of-Thumb ((Blundell et al., 2001))

	Pooled OLS	OLS fixed-effects	One-step difference GMM	Two-step difference GMM
l. Life satisfaction	0.616***	0.079***	0.090***	0.085***
	(0.02)	(0.02)	(0.03)	(0.03)
Informal	-0.033	-0.064**	-0.139***	-0.071*
	(0.02)	(0.03)	(0.05)	(0.04)
Gender	0.017			
	(0.02)			
Age categories. Ref: 15-24				
25-34	0.157**	0.231**	0.178	0.269
	(0.07)	(0.12)	(0.17)	(0.18)
35-44	0.106	0.272**	0.247	0.370*
	(0.07)	(0.14)	(0.19)	(0.19)
45-54	0.107	0.240	0.217	0.382*
	(0.07)	(0.16)	(0.21)	(0.21)
55-64	0.172**	0.245	0.264	0.405*
	(0.07)	(0.17)	(0.23)	(0.22)
65 and over	0.117	0.146	0.210	0.427*
	(0.08)	(0.18)	(0.24)	(0.23)
Objective health	0.169***	0.111**	-0.037	-0.061
	(0.02)	(0.05)	(0.11)	(0.10)
Marital status. Ref: Single				
Married without children	0.141***	-0.053	0.049	0.040
	(0.03)	(0.10)	(0.26)	(0.20)
Married with children	-0.048	-0.007	0.270	0.321
	(0.07)	(0.13)	(0.29)	(0.27)
Single with children	-0.285***	0.041	0.455	0.403
	(0.08)	(0.16)	(0.31)	(0.30)
Other	-0.188**	-0.275	-0.731	-0.753
	(0.08)	(0.23)	(0.55)	(0.46)
Educational status: Ref: Primary school				
Intermediate secondary education	-0.006	-0.472	-0.494	-0.447
	(0.06)	(0.34)	(0.59)	(0.65)
Higher secondary education	-0.045	-0.479	-1.110**	-1.299*
	(0.06)	(0.35)	(0.54)	(0.67)
Intermediate vocational education	-0.029	-0.554	-1.409**	-1.733**
	(0.06)	(0.35)	(0.69)	(0.78)
Higher vocational education	0.012	-0.332	-0.342	-0.727
	(0.06)	(0.37)	(0.68)	(0.80)
University	0.038	-0.394	-0.877	-1.239
	(0.06)	(0.39)	(0.72)	(0.80)
Others	-0.089	-0.589	-1.012	-1.484*
	(0.10)	(0.55)	(0.74)	(0.81)
Not yet completed any education	0.146	-0.335	-1.021*	-0.850
	(0.16)	(0.32)	(0.52)	(0.67)
Not yet started any education	-1.217***	-1.385***	-1.042***	-1.324
	(0.07)	(0.31)	(0.25)	(2.70)
Labour force status. Ref: Employed or self-employed				
Unemployed	-0.324***	-0.274***	-0.288**	-0.318***
	(0.10)	(0.09)	(0.13)	(0.12)
Out of the labor force	0.119***	0.197***	0.136	0.096
	(0.04)	(0.05)	(0.11)	(0.12)
Children	0.050**	-0.143***	-0.185*	-0.245**
	(0.03)	(0.04)	(0.11)	(0.12)
Working hours	0.001	-0.002	-0.002	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Household income	0.046**	0.016	-0.168*	-0.171***
	(0.02)	(0.02)	(0.09)	(0.06)
Living environment. Ref: Extremely urban				
Very urban	-0.041	-0.189	-0.366	-0.511
	(0.04)	(0.27)	(0.54)	(0.49)
Moderately urban	0.005	0.192	0.552	0.923*
	(0.04)	(0.27)	(0.54)	(0.52)
Slightly urban	0.015	0.104	0.092	0.472
	(0.04)	(0.26)	(0.75)	(0.68)
Not urban	0.022	-0.044	-0.165	0.148
	(0.04)	(0.25)	(0.54)	(0.52)
Constant	2.095***	6.921***		
	(0.22)	(0.51)		
Observations	9180	9180	8045	8045
Time fixed-effects	Yes	Yes	Yes	Yes

Standard errors are in parenthesis. * p<0.10, ** p<0.05, *** p<0.010. The sample includes 1188 individuals.

B.3 Endogeneity issues

Table B.3.1: The impact of life satisfaction on the decision to care

	OLS estimates: the decision to provide care	
	Total sample	Total sample
Life satisfaction	-0.013**	-0.012**
	(0.01)	(0.01)
l. Life satisfaction	-	-0.011**
		(0.01)
Gender	-	-
Age categories. Ref: 15-24		
25-34	0.036	0.036
	(0.05)	(0.05)
35-44	-0.006	-0.007
	(0.06)	(0.06)
45-54	0.058	0.057
	(0.06)	(0.06)
55-64	0.066	0.065
	(0.07)	(0.07)
65 and over	0.004	0.003
	(0.08)	(0.08)
Objective health	-0.012	-0.011
	(0.02)	(0.02)
Marital status. Ref: Single		
Married without children	0.080*	0.083*
	(0.05)	(0.05)
Married with children	0.047	0.050
	(0.06)	(0.06)
Single with children	0.074	0.075
	(0.07)	(0.07)
Other	-0.101	-0.101
	(0.08)	(0.08)
Educational status: Ref: Primary school		
Intermediate secondary education	-0.010	-0.012
	(0.07)	(0.07)
Higher secondary education	0.004	0.003
	(0.07)	(0.07)
Intermediate vocational education	0.014	0.013
	(0.07)	(0.07)
Higher vocational education	0.021	0.022
	(0.09)	(0.09)
University	0.078	0.079
	(0.08)	(0.08)
Others	0.064	0.064
	(0.11)	(0.10)
Not yet completed any education	0.187	0.181
	(0.15)	(0.15)
Not yet started any education	-0.062	-0.057
	(0.07)	(0.07)
Labour force status. Ref : Employed or self-employed		
Unemployed	0.048	0.048
	(0.04)	(0.04)
Out of the labor force	0.045	0.046*
	(0.03)	(0.03)
Children	0.019	0.018
	(0.02)	(0.02)
Working hours	-0.002**	-0.002**
	(0.00)	(0.00)
Household income	0.024	0.025
	(0.02)	(0.02)
Living environment. Ref: Extremely urban		
Very urban	-0.120	-0.121
	(0.09)	(0.09)
Moderately urban	-0.111	-0.112
	(0.10)	(0.10)
Slightly urban	-0.093	-0.090
	(0.09)	(0.09)
Not urban	-0.232**	-0.228**
	(0.12)	(0.11)
Constant	0.200	0.268
	(0.22)	(0.22)
Observations	9180	9180
Time fixed-effects	Yes	Yes

Standard errors are in parenthesis.* p<0.10, ** p<0.05, *** p<0.010. The sample includes 1188 individuals.

Table B.3.2: The augmented regression test (Durbin-Wu-Hausman, detailed)

	Pooled OLS	OLS with fixed-effects
	The informal care decision	Life satisfaction
Informal		4.903*
		(2.83)
Residuals		-4.972*
		(2.83)
Gender	0.101***	-
	(0.02)	
Age categories. Ref: 15-24		
25-34	0.066*	-0.092
	(0.04)	(0.22)
35-44	0.101***	-0.231
	(0.04)	(0.32)
45-54	0.273***	-1.125
	(0.04)	(0.79)
55-64	0.294***	-1.223
	(0.04)	(0.84)
65 and over	0.244***	-1.076
	(0.04)	(0.71)
Objective health	-0.034*	0.289***
	(0.02)	(0.11)
Marital status. Ref: Single		
Married without children	0.051**	-0.289*
	(0.02)	(0.17)
Married with children	0.038	-0.176
	(0.04)	(0.17)
Single with children	0.051	-0.201
	(0.06)	(0.23)
Other	0.100*	-0.776**
	(0.06)	(0.35)
Marital status. Ref: Primary school		
Intermediate secondary education	0.020	-0.589*
	(0.04)	(0.34)
Higher secondary education	0.038	-0.679*
	(0.05)	(0.36)
Intermediate vocational education	0.025	-0.689**
	(0.04)	(0.35)
Higher vocational education	0.038	-0.513
	(0.05)	(0.38)
University	0.118**	-0.975*
	(0.06)	(0.52)
Others	0.097	-1.076*
	(0.07)	(0.60)
Not yet completed any education	0.313**	-1.934**
	(0.15)	(0.95)
Not yet started any education	0.108**	-1.891***
	(0.05)	(0.42)
Labour force status. Ref : Employed or self-employed		
Unemployed	0.086*	-0.702***
	(0.04)	(0.26)
Out of the labor force	0.011	0.149**
	(0.03)	(0.06)
Children	0.011	-0.206***
	(0.02)	(0.06)
Working hours	-0.002***	0.010
	(0.00)	(0.01)
Household income	-0.011	0.074**
	(0.01)	(0.04)
Living environment. Ref: Extremely urban		
Very urban	-0.010	-0.147
	(0.03)	(0.28)
Moderately urban	-0.033	0.352
	(0.03)	(0.29)
Slightly urban	-0.003	0.144
	(0.04)	(0.27)
Not urban	0.007	-0.054
	(0.04)	(0.26)
Constant	-0.051	6.955***
	(0.13)	(0.57)
Observations	9180	9180
Time fixed-effects	Yes	Yes
Residuals test Prob > chi2 = 0.079		

Standard errors are in parenthesis. In the first column, standard errors are clustered at the individual level. * p<0.10, ** p<0.05, *** p<0.010.
The sample includes 1188 individuals.

C Detailed results

Table C.1.1: OLS and two-step system GMM estimates of life satisfaction

	Pooled OLS	OLS with fixed-effects	Two-step system GMM, instrument from second lag to third lag dependent variable	Two-step system GMM, instrument from third lag to fourth lag dependent variable
	Model (1)	Model (2)	Model (3)	Model (4)
l. Life satisfaction			0.088***	0.066***
			(0.01)	(0.01)
Informal	-0.121***	-0.070**	-0.087***	-0.086***
	(0.05)	(0.03)	(0.02)	(0.02)
Gender	0.047	-	-0.047	-0.050
	(0.06)		(0.03)	(0.03)
Age categories. Ref: 15-24				
25-34	0.269*	0.234*	0.169***	0.228***
	(0.14)	(0.12)	(0.05)	(0.05)
35-44	0.152	0.270*	0.064	0.103**
	(0.15)	(0.15)	(0.06)	(0.05)
45-54	0.159	0.232	0.059	0.101*
	(0.15)	(0.16)	(0.06)	(0.05)
55-64	0.274*	0.237	0.173***	0.197***
	(0.15)	(0.18)	(0.06)	(0.06)
65 and over	0.250	0.137	0.117	0.136*
	(0.17)	(0.19)	(0.08)	(0.08)
Objective health	0.426***	0.121**	0.118***	0.121***
	(0.06)	(0.05)	(0.04)	(0.04)
Marital status. Ref: Single				
Married without children	0.469***	-0.035	0.113	0.271***
	(0.07)	(0.11)	(0.07)	(0.07)
Married with children	0.010	0.016	0.126	0.231**
	(0.15)	(0.13)	(0.09)	(0.09)
Single with children	-0.687***	0.052	-0.552***	-0.472***
	(0.18)	(0.17)	(0.10)	(0.10)
Other	-0.318**	-0.277	-0.501***	-0.358***
	(0.15)	(0.24)	(0.09)	(0.09)
Educational status: Ref: Primary school				
Intermediate secondary education	-0.012	-0.491	-0.171**	-0.285***
	(0.13)	(0.34)	(0.07)	(0.06)
Higher secondary education	-0.148	-0.490	-0.440***	-0.362***
	(0.14)	(0.35)	(0.10)	(0.09)
Intermediate vocational education	-0.093	-0.567	-0.287***	-0.273***
	(0.13)	(0.35)	(0.10)	(0.10)
Higher vocational education	0.016	-0.322	0.053	0.023
	(0.13)	(0.37)	(0.09)	(0.08)
University	0.022	-0.389	0.053	0.039
	(0.14)	(0.40)	(0.10)	(0.10)
Others	-0.234	-0.593	-0.766***	-0.679***
	(0.21)	(0.54)	(0.11)	(0.10)
Not yet completed any education	-0.080	-0.376	-0.229**	-0.254**
	(0.18)	(0.31)	(0.11)	(0.10)
Not yet started any education	-1.319***	-1.356***	-1.123***	-1.156***
	(0.16)	(0.30)	(0.26)	(0.25)
Labour force status. Ref: Employed or self-employed				
Unemployed	-0.422***	-0.276***	-0.259***	-0.284***
	(0.13)	(0.09)	(0.06)	(0.06)
Out of the labor force	0.217***	0.203***	0.152***	0.173***
	(0.08)	(0.05)	(0.06)	(0.06)
Children	0.129**	-0.151***	0.008	0.013
	(0.05)	(0.05)	(0.04)	(0.04)
Working hours	0.002	-0.002*	-0.005***	-0.004***
	(0.00)	(0.00)	(0.00)	(0.00)
Household income	0.123***	0.019	-0.067***	-0.089***
	(0.05)	(0.02)	(0.02)	(0.02)
Living environment. Ref: Extremely urban				
Very urban	-0.147	-0.198	-0.193**	-0.163*
	(0.10)	(0.28)	(0.09)	(0.10)
Moderately urban	-0.038	0.187	0.456***	0.425***
	(0.10)	(0.28)	(0.10)	(0.09)
Slightly urban	0.031	0.128	-0.159*	-0.146
	(0.10)	(0.27)	(0.09)	(0.09)
Not urban	0.044	-0.019	0.527***	0.580***
	(0.10)	(0.26)	(0.09)	(0.08)
Constant	5.425***	7.485***	7.309***	7.484***
	(0.44)	(0.46)	(0.23)	(0.20)
Number of observations	9180	9180	9180	9180
Number of groups	1188	1188	1188	1188
Time fixed-effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
R-squared	0.10	0.02		
Number of instruments			474	470
AR(1)			0.000	0.000
AR(2)			0.067	0.131
Hansen test			0.777	0.508

Standard errors are in parenthesis. In the first column, standard errors are clustered at the individual level. * p<0.10, ** p<0.05, *** p<0.010
All explanatory variables –except for time dummies, gender and age categories –are treated as endogenous.
We instrument the lag of the life satisfaction with its first and second lags in Model (3).
We instrument the lag of the life satisfaction with its second and third lags in Model (4).
We instrument other endogenous regressors with their first and second lags.

Table C.1.2: Alternative specifications

	Two-step system GMM estimates on life satisfaction/life happiness				
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
l. Happiness	0.032***				
	(0.01)				
l. Life satisfaction		0.086***	-0.003	-0.058***	0.034***
		(0.01)	(0.01)	(0.02)	(0.01)
Informal	-0.117***		-0.152***	-0.170***	-0.082***
	(0.02)		(0.05)	(0.04)	(0.03)
Frequency		-0.006***			
		(0.00)			
Gender	-0.008	-0.059*	0.030	-0.018	-0.054
	(0.03)	(0.03)	(0.05)	(0.05)	(0.03)
Age categories. Ref: 15-24					
25-34	0.119***	0.219***	0.182***	0.299***	0.297***
	(0.04)	(0.05)	(0.05)	(0.09)	(0.05)
35-44	-0.040	0.105**	0.151*	0.200**	0.083
	(0.05)	(0.05)	(0.08)	(0.10)	(0.05)
45-54	0.031	0.094*	0.105	0.258***	0.118**
	(0.05)	(0.05)	(0.08)	(0.09)	(0.05)
54-64	0.136***	0.208***	0.140*	0.443***	0.236***
	(0.05)	(0.06)	(0.08)	(0.08)	(0.06)
65 and over	0.050	0.151**	0.099	0.476***	0.237***
	(0.06)	(0.07)	(0.10)	(0.10)	(0.08)
Objective health	0.156***	0.099**	0.087	0.358***	0.180***
	(0.03)	(0.04)	(0.07)	(0.06)	(0.05)
Marital status. Ref: Single					
Married without children	0.058	0.216***	0.663***	0.362***	0.074
	(0.05)	(0.06)	(0.08)	(0.07)	(0.06)
Married with children	-0.015	0.216**	0.474***	0.156	0.152*
	(0.06)	(0.09)	(0.14)	(0.15)	(0.09)
Single with children	-0.754***	-0.473***	0.188	-0.588***	-0.975***
	(0.08)	(0.10)	(0.17)	(0.17)	(0.11)
Others	-0.507***	-0.237***	-0.028	-0.497***	-0.558***
	(0.07)	(0.09)	(0.14)	(0.10)	(0.10)
Educational status: Ref: Primary school					
Intermediate secondary education	-0.160**	-0.200***	-0.171	0.446***	-0.302***
	(0.07)	(0.06)	(0.12)	(0.15)	(0.06)
Higher secondary education	-0.476***	-0.316***	-0.270**	0.703***	-0.412***
	(0.07)	(0.08)	(0.12)	(0.14)	(0.09)
Intermediate vocational education	-0.046	-0.195**	0.111	0.600***	-0.229**
	(0.08)	(0.09)	(0.10)	(0.14)	(0.10)
Higher vocational education	0.033	0.102	0.198*	0.681***	-0.198**
	(0.07)	(0.07)	(0.11)	(0.13)	(0.09)
University	0.144	0.111	-0.034	0.632***	-0.127
	(0.09)	(0.09)	(0.11)	(0.14)	(0.09)
Others	-0.682***	-0.516***	-1.166***	0.044	-1.124***
	(0.15)	(0.09)	(0.21)	(0.15)	(0.09)
Not yet completed any education	-0.403***	-0.196**	0.395***	0.705***	-0.816***
	(0.09)	(0.09)	(0.15)	(0.12)	(0.09)
Not yet started any education	-2.115***	-1.043***	16.394***	19.109***	-1.266***
	(0.27)	(0.25)	(5.92)	(6.48)	(0.19)
Labour force status. Ref : Employed or self-employed					
Unemployed	-0.014	-0.287***	-0.579***	-0.505***	-0.250***
	(0.02)	(0.06)	(0.14)	(0.17)	(0.06)
Out of the labor force	0.130***	0.160***	0.372***	0.060	0.220***
	(0.04)	(0.05)	(0.07)	(0.10)	(0.06)
Children	0.099***	0.008	-0.011	0.098	0.016
	(0.02)	(0.04)	(0.05)	(0.07)	(0.04)
Working hours	-0.005***	-0.004***	0.000	-0.004	-0.003**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Household income	-0.086***	-0.099***	-0.030	-0.075**	-0.087***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)

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	Two-step system GMM estimates on life satisfaction/life happiness				
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Living environment. Ref: Extremely urban					
Moderately urban	-0.131*	-0.136	0.041	-0.730***	-0.301***
	(0.07)	(0.10)	(0.11)	(0.07)	(0.10)
Slightly urban	0.253***	0.379***	0.331***	0.102	0.399***
	(0.07)	(0.09)	(0.11)	(0.08)	(0.09)
Not urban	0.016	-0.213**	0.249*	-0.160	-0.376***
	(0.09)	(0.10)	(0.13)	(0.12)	(0.07)
Not urban	0.569***	0.499***	0.910***	-0.192	0.690***
	(0.08)	(0.08)	(0.11)	(0.12)	(0.09)
Constant	7.798***	7.451***	6.768***	7.281***	7.857***
	(0.19)	(0.19)	(0.31)	(0.36)	(0.24)
Observations	9013	9180	9180	9180	7196
Number of groups	1188	1188	1188	1188	1176
Time fixed-effects	Yes	Yes	Yes	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes
Number of instruments	469	470	408	382	426
AR(1)	0.000	0.000	0.000	0.000	0.000
AR(2)	0.208	0.075	0.535	0.664	0.283
Hansen test	0.304	0.603	0.125	0.512	0.492

Standard errors are in parenthesis. * p<0.10, ** p<0.05, *** p<0.010

All explanatory variables –except for time dummies, gender and age categories –are treated as endogenous.

In all models, we instrument the lag of the life satisfaction with its second and third lags.

We instrument other endogenous regressors with their first and second lags in Model (1), (2) and Model (5).

We instrument other endogenous regressors with their second and third lags in Model (3).

We instrument other endogenous regressors with their third and fourth lags in Model (4).