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A note on the concavity of the happiness function in family support

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Abstract

In the happiness literature, there is an extensive debate about the diminishing marginal utility of income. However, this issue is neglected when considering another critical driver of happiness, social capital, and specifically, family support. The latter has been defended as a possible explanation of the relatively high happiness levels in Latin America. In this note, we present a preliminary comparison of the marginal impact of family support and income on the levels of happiness for Latin Americans and USA citizens. The primary goal is to discuss the possibility of diminishing returns to family support. By using different measures of family support and different models, we find that the marginal effect on happiness of income and family support are higher in the region with lower average endowments of those variables. In addition, the contribution of family support to happiness is systematically higher than the contribution of income. However, the assumption of a non-linear contribution of family support seems not to be crucial to understanding the relative impact of this variable on happiness for the individual with mean support in Latin American and the United States. More research is needed to improve our measures of family support and to understand their effects on happiness.

1. Introduction

Latin American countries show a high level of happiness[1] relatively to their low levels of some traditional variables considered as determinants of happiness, such as income or health. Mariano Rojas (2016; 2018; Rojas *et al.* 2018) argues that the so-called 'Latin American paradox' might result from the exclusive focus on economic indicators, and from neglecting essential aspects in the life of people, such as family relations.

The question about the relative importance of the family or income in different countries crucially depends on several assumptions about the production function of happiness (or utility function). The family may have a more prominent role in Latin America than in the United States of America (USA), but if family support presents diminishing returns, the contribution of an additional unit should be lower in Latin America.

The goal of the present note is to compare the marginal impact of family support[2] and income on the levels of happiness of Latin Americans and USA citizens. On the one hand, diminishing returns imply that the effect on happiness of a marginal addition of income or family support will be higher in the country with lower levels of those variables. On the other hand, within each country, diminishing marginal utility implies that individuals with higher levels of a specific driver will obtain lower happiness from an additional unit.

Some authors are critical of the hypothesis of diminishing marginal utility of income. See, for example, the distinct arguments of Easterlin (2005) and Oswald (2008). Sacks *et al.* (2012) and Stevenson and Wolfers (2013) did not find a satiation point beyond which the relationship between income and well-being diminishes. Conversely, Jebb *et al.* (2018) found evidence of income satiation in three different components of well-being. For these last authors, Latin America satiates at relatively low levels of income. Therefore, the degree of concavity of happiness in income is controversial.

Our purpose is to extend the debate on concavity to social capital and, more specifically, to family support. The theory of social capital provides a framework to understand how social relations influence individuals' outcomes. Social relations provide embeddedness in systems of norms, control and trust (Coleman 1988) and access to information and social support (Antonucci and Akiyama 1995). Indeed, social relations facilitate social capital, which is crucial for health and other outcomes relevant for happiness (House *et al.* 1988; Rowe and Kahn 1998). In the literature on social capital,[3] these are regarded as positive effects of bonding social capital. In line with Putman (2000), the existence of a circle of strong ties enables the person to achieve a group of unconditional support, which helps to face social risks and uncertainty. Family relations can thus be regarded as a form of 'capital', because it is possible to invest in their maintenance and development, and they provide returns in terms of happiness. Now, if we further the analogy of 'capital', diminishing marginal utility is a natural hypothesis. Helliwell *et al.* (2019) show a positive effect of social support by relatives or friends on happiness, while few other authors, such as Aumeboonsuke (2017) or Huang (2018), focus on the family directly. In Latin American countries, the family might be the primary source of strong ties and bonding social capital (Rojas 2016; Neira *et al.* 2019).

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[1] In this paper we use interchangeably terms as 'utility', 'happiness' or 'well-being'. We reflect on the possible non-linear effects of family support, and not about implications for happiness, life satisfaction or emotional well-being.

[2] The multidimensional concept of family support may be interpreted in a purely instrumental way. However, the use of this term is not intended to neglect other mechanisms that explain the contribution of the family to personal happiness, such as enjoyment and identity, among others.

[3] See, for instance, the review by Membiela-Pollán and Pena-López (2017).

However, the possibility of diminishing returns to family has generally been neglected in the social capital debates.

The main contribution of this paper is the proposal of a specific hypothesis about the concavity of critical drivers of happiness, namely family support. This hypothesis, which is usually discussed within the debate about the relevance of income, may have relevant implications in the study of happiness. To this end, we use data from a survey in three Latin American countries (Mexico, Costa Rica and Colombia) and the USA, which includes specific questions about family relationships. That data comes from the Understanding High Happiness in Latin America Project (Rojas *et al.* 2018). This database allows for analyzing the issue of concavity in terms of both cross- and intra-country differences. In particular, we compare our analysis for two variables of family support. One is a dummy variable, and the other one is a continuous variable derived from principal components analysis. For two continuous variables of income and family support, we study the relative estimates USA/Latin America in a happiness regression, considering linear and non-linear models. This procedure permits to study the relative contribution of each variable to happiness in both subsamples.

Our preliminary results reveal that the estimates of family support are higher in the sample for the United States and the estimates of income are higher in the Latin American sample, in accordance with the hypothesis of diminishing returns. However, our data on family support do not reveal large differences between Latin America and the USA. On considering an individual with mean family support, the results about diminishing returns to family support are not crucial to understanding the relative impact on happiness. Moreover, we find consistent evidence that family support contributes more to happiness than income.

2. Methodology

To fix ideas, we start reminding the approach followed by the World Happiness Report (WHR), using continuous data, country averages of survey data or national accounts. Adapting it to the variables of interest for the present paper, the model estimated by Helliwell *et al.* (2019) can be represented by the following equation:

$$H = a + b_1 C + b_2 \log I + b_3 FS + \varepsilon \qquad \varepsilon \sim \mathcal{N}(0, \sigma^2) \tag{1}$$

where H is an index of happiness; C is a set of control variables; I is a variable of income and FS is a variable of family support (social support, in the WHR). Equation (1) represents a linear-log model in income, to captures the diminishing marginal utility of income. The marginal effect of income decreases with income: $\delta H / \delta I = b_1 / I$. A 1% increase in I is expected to raise H in approximately $b_1 / 100$ units. The (natural) log scale 'squishes' the original data, and hence the same increase in H requires ever greater increases in I.

A critical assumption of equation (1) is additivity: the marginal contribution of each variable does not depend on the level of the other explanatory variable. An alternative approach is the following log-log model, which is the transformation of a multiplicative model:[4]

$$\log H = \log a + b_1 \log C + b_2 \log I + b_3 \log FS + \varepsilon \qquad \varepsilon \sim \mathcal{N}(0, \sigma^2) \tag{2}$$

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[4] Equation (2) corresponds to a multiplicative model that is not exactly the same than the non-linear model estimated by Tofallis (2019) using the WHR data. See Xiao *et al.* (2011).

In equation (2), b_2 can be interpreted as the elasticity of H to I, which is the ratio of the marginal utility of income to the average utility of income. If H is ineslastic to I ($b_2<1$), there is diminishing returns to income.

However, when working with survey data for individuals, as we do, the dependent variable is ordinal ('very happy', 'quite happy'...). Technically, it does not make sense to assume the previous models. However, Ferrer-i-Carbonell and Frijters (2004) show that "assuming ordinality or cardinality of happiness scores makes little difference" in happiness research. In this same field, Frey and Stutzer (2002), Pittau *et al.* (2010), Aslam and Corrado (2012) or Salinas *et al.* (2011), among others, have confirmed the similar qualitative results when estimating linear or ordered logit/probit models.[5] Since the coefficients of these latter models are hard to interpret and compare, we will present here the results using ordinary least squares (OLS). In section 5 we will discuss additional results using ordered logit models.

Therefore, here, we assume that H is a cardinal indicator of happiness. Our discussion is useful but straightforward. First, in Model I and II of Table II below, we will compare the consequences of measuring family support with a dummy or a continuous variable, under the following equation:

$$H = a + b_1 C + b_2 I + b_3 FS + \varepsilon \tag{3}$$

Then, we estimate a linear-log model for both income and the continuous variable of family support (Model III):

$$H = a + b_1 C + b_2 \log I + b_3 \log FS + \varepsilon \tag{4}$$

Our research is about two different sides of diminishing marginal utility to income or family support. On the one side, for international comparisons, that concept implies that the effect on happiness of a marginal addition of I or FS will be higher in the country or sample with a lower level of I or FS, respectively. That possible effect would be observed by a comparison of b_2 and b_3 for Latin America and the USA in equations (3) and (4). On the other hand, for an interpersonal comparison inside each country, only equation (4) captures the idea of lower contribution to happiness from additional units of income or support for the individuals with higher endowments of those variables.

3. Data

The empirical analysis makes use of data from the Understanding High Happiness in Latin America Project (Rojas *et al.* 2018). A survey was conducted in three Latin American countries (Colombia, Costa Rica and Mexico) and the United States for comparison. The original sample includes 2,857 observations for the three Latin American countries and 1,340 for the United States. Due to the similarities among Latin American countries, we have grouped Colombia, Costa Rica and Mexico together.[6]

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[5] More generally, for a binary outcome, there is some statistical literature about the conditions under which the (OLS) linear probability model is a practical choice versus logit/probit models. For an ordinal outcome, the issue has been less studied. See Larrabee *et al.* (2014).

[6] The distribution of educational and income levels, for instance, is comparable among Latin American countries. Indeed, country-level differences in terms of happiness, family support and other interest variables are not statistically significant; see Table I for the average levels. An additional relevant issue is the ethnicity of U.S. residents. Hispanics account for about 18% of the U.S. population (about 20% in our sample). When culture and social norms regarding the structure of the family play a role in the studied association, migration of Hispanics has interesting implications. While we are not able to address this question with our sample, mainly due to the limited size of the U.S. subsample, this is undoubtedly an attractive line for future research.

Our dependent variable is a variable of happiness from the following question: "Taking all things together in your life, how happy would you say you are?". The answer is divided into 7 categories, from "extremely unhappy" to "extremely happy".

The survey includes a categorical question on family support: "In my family, we help and support each other a lot...", with an answer divided into five levels from "strongly disagree", to "strongly agree". A key issue might be the possibility of different national interpretations to the meaning of "a lot" of family help and support in this survey question. We have built two dichotomous variables, as shown in Table I, and one of them is used in Model I of Table II. However, income is a continuous variable in Purchasing Power Parities (PPP). Therefore, we want to estimate Models II and III using a continuous variable of family support.

In the present preliminary analysis, we focus on family support, but we think of it from the point of view of social capital. Therefore, we have developed our measure of family support using an integrated approach to social capital, through principal component analysis of a large battery of questions about social life for the joint sample of the four countries under research. The resulting components can be interpreted as associativity, work relations, social interactions with friends and neighbors, and family relations. Appendix I provides details about the questions and the methodology being used to construct our measure of family support. The family-specific factor reduces to a normalized score the answers to three questions about the number of times a month the individual spends time with her mother, father and brother and sisters. Strictly speaking, the amount of family time is not a measure of family support, but it is an indicator free of context-dependent interpretations. In this paper, we assume that there is a monotonous positive relationship between family support and the time spent with parents, brothers and sisters.

Table I - Summary of variables of happiness, income and family support

Variables	Latin America		USA	
	Mean	*Standard deviation*	*Mean*	*Standard deviation*
Happiness, increasing from 1 to 7	5.670	0.920	5.112	1.301
Life satisfaction, increasing from 1 to 7	5.660	0.977	5.125	1.368
Income, in comparable PPP units	0.107	0.145	0.545	0.664
Family support (FS), increasing from 1 to 5	4.175	0.892	3.757	1.111
Family support high is 1 if FS is 4 or 5, 0 otherwise	0.860	0.347	0.677	0.468
Family support very high is 1 if FS is 5, 0 otherwise	0.402	0.490	0.273	0.446
Family support, increasing continuous variable	0.127	1.004	-0.264	0.939

Table I presents the means and standard deviations for some variables of interest. In our sample, the three Latin American countries present similar average levels of happiness, which are higher than the average for the USA.[7] Additionally, our data of Latin American countries exhibit lower average income and higher levels of family support than the USA. However, the difference of income between the two regions is very high, compared to the size of the standard deviations, while this is not true for the continuous variable of family support. For this last variable, which is standardized for the joint sample, the difference of means between samples is only 0.39 points, for averages close to zero and standard deviation close to one. Moreover, the correlation between income and the continuous variable of family support is zero in both samples.

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[7] In the ranking of happiness 2016-2018 of the WHR 2019, Costa Rica has higher levels of happiness than the USA, while this last country exhibits higher levels than Mexico and Colombia.

Figure 1 - Log of income and family support in the joint sample for the four countries
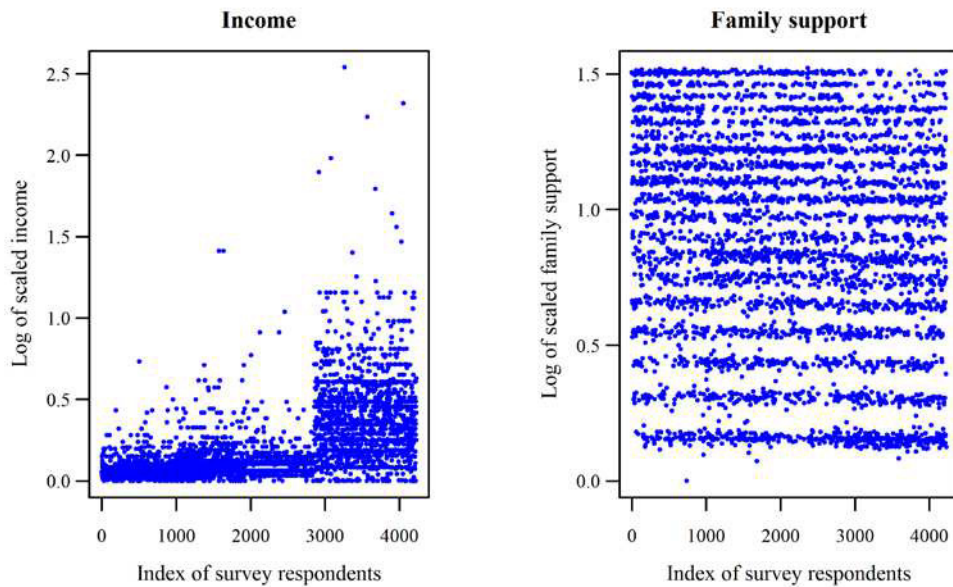
The reason can be observed in Figure 1. For the regressions in Table II below, the two continuous variables are scaled up to avoid the natural logarithm of zero or negative values, so the minimum value of the logarithms is zero. Figure 1 shows the logarithm of the scaled values of income and family support. The observations for the USA are indexed from 2,858 to 4,227; hence the left plot reveals the higher average incomes in this country. Additionally, we can observe the unequal distribution of income, with most observations in middle and low levels, by subsamples. However, by constructions, the log of the scaled family support displays a much more uniform distribution. This measure was obtained by transforming a weighted sum of numerical answers to three questions, and it is not possible to identify obvious values with higher probabilities in the data. Even more, aside from some different density of points at very high and very low family support for the USA, there are no distinguishable patters to compare the subsamples of the USA and Latin America.

We consider a few additional control variables, though the sample size does not allow for a high number of statistically significant control variables. We control for having or not a relationship with someone and trusting or not most people. Religiosity captures if the individual professes any religion, and offspring captures having or not any descendants. From a 7-level categorical variable about health status, we built two dichotomous variables for good health and very good (or excellent) health. In the models presented in Table II below, some classical variables, as gender or age, are not statistically significant. Age is negatively correlated to the continuous variable of family support: the higher the age, the lower the amount of time spent with parents and brothers and sisters.[8] Country dummies for Latin American countries are not significant either.

4. Results

Table II reveals that the estimates of income are higher for Latin America than for the USA in the three models.[9] Conversely, the estimates of family support are lower for Latin America

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[8] It should be noticed that the square of age is also estimated in many studies, such as Neira *et al.* (2018). However, in our robustness tests about Table II the square of family support is not statistically significant.

[9] The estimate of family support is identical to the one of Model II even if income is considered in logarithms (not shown). Therefore, Table II displays the marginal contribution of family support in a linear or logarithmic form, independently of income being in linear or logarithmic form.

than for the USA in the three models. These results are consistent with diminishing marginal utility of both income and family support: the higher the average level of each of those variables in a country, the lower the amount of happiness obtained by an additional unit of income or family support. The linear-log Model III captures that effect both for the individuals in the same sample and for individuals in different samples.

However, diminishing returns do not work similarly for income and family support for the average individual in each subsample, as we have confirmed in a simulation available upon request. The ratio of the scaled mean income between the USA and Latin America is 1.4, which becomes 4.3 when that ratio is calculated with the logs of those mean values. Therefore, in Model III, the contribution of income to happiness for the individual with mean income is more than three times higher in the USA than in Latin America, despite the estimate of income is higher for Latin America. Conversely, the ratio of scaled mean family support between the USA and Latin America appears to be very similar to the ratio of the logs of those means. Therefore, the contribution of *FS* to happiness for the individual with mean *FS* is 1.3-1.5 times higher in USA than in Latin America in both Model II and III. In other words, the assumption of diminishing returns is crucial to measure the relative impact of income in both countries for an individual with mean income but has not relevant consequences to measure the relative impact of family support in both regions for an individual with mean family support.

Table II - OLS estimations of happiness for Mexico, Costa Rica and Colombia and for the USA

Predictors	Model I				Model II				Model III			
	Latin America		USA		Latin America		USA		Latin America		USA	
	b	p	b	p	b	p	b	p	b	p	b	p
Relationship	0.18	**<0.001**	0.42	**<0.001**	0.20	**<0.001**	0.48	**<0.001**	0.19	**<0.001**	0.44	**<0.001**
Trust	0.18	**0.008**	0.29	**<0.001**	0.19	**0.006**	0.36	**<0.001**	0.19	**0.008**	0.35	**<0.001**
Religiosity	0.16	**0.004**	0.15	**0.032**	0.16	**0.004**	0.18	**0.012**	0.16	**0.004**	0.19	**0.008**
Health: good	0.35	**<0.001**	0.37	**<0.001**	0.34	**<0.001**	0.46	**<0.001**	0.34	**<0.001**	0.44	**<0.001**
Health: very good	0.60	**<0.001**	0.91	**<0.001**	0.59	**<0.001**	0.97	**<0.001**	0.59	**<0.001**	0.95	**<0.001**
Offspring	0.05	0.263	0.05	0.464	0.13	**0.003**	0.13	0.064	0.12	**0.005**	0.13	0.062
Income	0.30	**0.011**	0.11	**0.016**	0.34	**0.004**	0.13	**0.008**				
FS: high	0.43	**<0.001**	0.71	**<0.001**								
FS continuous					0.13	**<0.001**	0.19	**<0.001**				
Log income									0.59	**0.001**	0.46	**<0.001**
Log FS continuous									0.32	**<0.001**	0.43	**<0.001**
Observations	2390		1306		2396		1329		2396		1329	
R²	0.132		0.287		0.127		0.251		0.127		0.256	

Note: The intercept is not shown. The dependent variable is categorical.

Finally, for each of the previous models, Table III shows the effects of income and family support in comparable units, using two different standardization methods. The *Beta* parameters measure the effects on happiness of a change of one (or two) standard deviations of each predictor. The standardized coefficient of family support is consistently higher than the one of income. Moreover, when comparing that higher relative importance for the same standardization method, the difference is more important for Latin American than for the USA, except for *B1* in Model I.

Table III - Standardized coefficients of income and family support

	Model I				Model II				Model III			
	Latin Am.		USA		Latin Am.		USA		Latin Am.		USA	
	B1	*B2*	*B1*	*B2*	*B1*	*B2*	*B1*	*B2*	*B1*	*B2*	*B1*	*B2*
Income (I)	0.05	0.09	0.06	0.15	0.06	0.10	0.07	0.17	0.06	0.11	0.10	0.25
Family support (FS)	0.16	0.43	0.25	0.71	0.15	0.26	0.14	0.36	0.14	0.25	0.14	0.36
FS / I	3.20	4.78	4.17	4.73	2.50	2.60	2.00	2.12	2.33	2.27	1.40	1.44

Note: *B1* is calculated by dividing the centered variable by one standard deviation while *B2* by two standard deviations, which is more appropriate in the presence of binary predictors (Gelman 2008).

5. Discussion and concluding remarks

We have presented the analysis of the hypothesis of diminishing returns by applying logarithms. However, we have also studied alternative methodological approaches. For instance, results in Model II of Table II are robust to the inclusion of squared variables, though the squared term is only statistically significant for income in the USA. We have estimated the three models in Table II by using ordered logit models. The estimated odds ratios confirm the pattern of diminishing returns: the estimates for income are higher for Latin American than for the USA, and the opposite holds true for family support. Additionally, following Salinas *et al.* (2011), we have repeated the estimation of these ordered logit models in subsamples of income terciles. Family support is significant in each of the six subsamples by terciles for the three models, with only one exception. Unlike Model II, the nonlinear model III points to higher odds ratios of family support in the USA for people in the lower and medium terciles of income.

In summary, we have shown preliminary evidence of diminishing returns to income and family support. The marginal effect on happiness of family support is higher in the USA than in the (three-country) Latin American sample, while the opposite holds true for income.

From the point of view of interpersonal comparisons, the assumption of diminishing marginal utility is crucial to evaluate the relative contribution to happiness for the individual with mean income in the USA and Latin America. Conversely, for our specific indicator of family support, the assumption of non-linearity is not crucial to assess the relative impact on happiness between the two regions for the individual with mean family support. More research is needed to improve our measures of family support and to understand its effects on happiness. In any case, we have found that the contribution of family support is systematically higher than that of income in both Latin America and the USA.

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Appendix I. Social relations and family support: Principal Component Analysis

The Understanding Happiness in Latin America survey (2018) is focused on personal relations, and hence, it includes a battery of questions that may be used to extract information on social life. Principal Component Analysis (PCA) has been applied to 14 different questions about personal relations and social capital as a dimensionality reduction technique. The first column of Table A.I presents these questions. Provided that all factors are likely to be related among themselves, oblique rotation is the appropriate choice for this analysis. Findings suggest retaining four factors, which respond to both a quantitative assessment of associated eigenvalues and to theoretical considerations (see Figure A.1 for a graphical representation of eigenvalues and number of factors). These factors account for 57% of the total variance. From a theoretical standpoint, they arrange questions related to, respectively, work relations, social interactions with friends and neighbours, family relations, and associativism. The corresponding pattern matrix is presented in Table A.I. The variable Family Support, which is used in the analysis, corresponds to the third component presented in Table A.I, and, in particular, to the normalised individual factor scores obtained by regression.
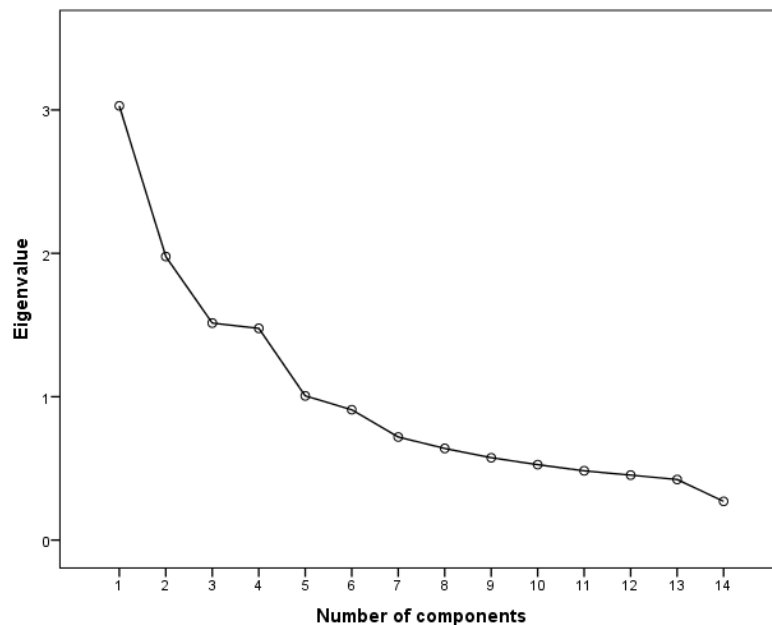

Figure A.1 PCA: Number of components and eigenvalues

Table A.I. PCA: pattern matrix

Question	Component			
	WORK	**FRIENDS**	**FAMILY**	**ASSOCIATIONS**
1 (And) how often do you meet up with the following people? (Your colleagues)	**0,880**	0,024	0,040	-0,008
2 Now tell me. How often do you and the following people speak –face to face or by phone- about your feelings, your interests and aspirations? (Your colleagues)	**0,865**	0,027	0,004	-0,024
3 Thinking about your work and your work colleagues, how often do you organise social events outside work?	**0,815**	0,025	0,029	-0,062
4 How many friends can you count on for support when you have economic problems?	0,164	**0,743**	0,001	0,090
5 How many friends can you count on to talk about your problems and feelings, apart from your family?	0,112	**0,777**	-0,077	0,083
6 How many of your neighbours do you know by their name?	-0,152	**0,618**	0,053	-0,081
7 How many people do you often interact with who are not relatives, friends or neighbours, you know by their name?	-0,060	**0,587**	0,035	-0,136
8 How many times a month do you spend time with your mother?	0,016	-0,07	**0,829**	0,028
9 How many times a month do you spend time with your father?	0,001	-0,023	**0,795**	-0,023
10 How many times a month do you spend time with your brothers and sisters?	0,009	0,089	**0,735**	0,020
11 Can you tell me if you participate in the following meetings or group events, and its frequency? (neighbours' organizations)	0,013	0,028	-0,011	**-0,794**
12 Can you tell me if you participate in the following meetings or group events, and its frequency? (other organizations)	0,037	-0,043	-0,026	**-0,747**
13 Can you tell me if you participate in the following meetings or group events, and its frequency? (labour unions)	0,202	-0,077	0,041	**-0,615**
14 Can you tell me if you participate in the following meetings or group events, and its frequency? (church or religious organization)	-0,108	0,094	-0,003	**-0,472**