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ESTIMATING *CAPABILITY* AS A LATENT VARIABLE: A MULTIPLE INDICATORS AND MULTIPLE CAUSES APPROACH
THE EXAMPLE OF HEALTH

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Abstract

Following Sen's approach to poverty, the 'real' poor are those who did not have the choice not to be poor. In other words, poor is an individual who did not have the *capability* (*i.e.* the possibility, the ability) to have a suitable income to survive on, a good level of health, a suitable habitat, a good level of education and so on and so forth. The capability approach was introduced for developing countries, thus it has to be readapted for the industrialized ones. In these countries it is necessary to assess the 'real' poverty in Sen's way of thinking. This is important for the implications of political economy that it involves. Among the several dimensions of poverty, we concentrate on the analysis of health because the capability of health is one of the most important constituent of our well-being. We can proceed with an econometric analysis to assess the link between the capability of being healthy and a set of exogenous variables, using the innovative statistics technique of MIMIC (Multiple Indicators and Multiple Choice) model for latent variables. We used the Italian dataset (wave 7, 2001) of the European Community Household Panel. The main results show that deprivation, in each dimensions considered, influences negatively the capability of health, even if healthy pepole are the most in the sample, the percentage of them decrease when we consider the state of deprivation. Mimic model confirms this explorative analysis, showing a correlation between all the exogenous variables considered and the capability of health.

Introduction

The Indian economist Amartya Kumar Sen, professor at Harvard University, is the father of the so-called "capability approach". In 1988 he received the Nobel Prize in Economy. Sen has contributed in many fields of investigation (such as the development economics, the contributions to the problems of the measurement of the dispersion of the income, the theory of collective choices): nevertheless, his greatest contribution of all is the analysis of poverty.

The capability approach has a multidimensional character, because it extends the number of dimensions by defining and measuring poverty with various variables. So, income is just one of the possible dimensions of poverty. The capability approach focuses the analysis on the quality of life more than on the wealth and gives, therefore, a more careful description of the phenomenon and a more suitable explanation of his causes.

So, though Sen recognizes that the income has an enormous influence in what it can or cannot do, he defines poverty not only in relation to monetary aspects, but above all as the kind of life that we would like and the possibility to live. In short, Sen did not want to eliminate the ambiguity in the definition of poverty, but rather to take advantage of it. Sen underlines that instead of giving importance to commodities to live comfortably, we must put in first place the realistic life that people want to live (taking one step forward, the freedom to value the importance of real lives).

In this context, Sen introduces the "Capability approach" to estimate first the inequality and then the individual poverty as lack of basic capability or as a failure in reaching a minimum level of subsistence.

Despite the capability approach it is widely recognised as one of the more satisfying and complete multidimensional approach there are, still, a few empirical applications[1].

The main problem is that it is difficult to assess the idea of freedom that is beyond the capability set and it is difficult to assess the whole set of opportunity that each person has to face during her life.

Thus, most studies on poverty within this approach focuses the attention on the selected functionings, they analyse the realizations more than the advantages.

[1] See, for Italy, Cheli, Lemmi (1995), Brandolini D'alessio (1998), Chiappero Martinetti (1994, 2000), Balestrino, Scicolone (2002)

There are some reasons to not proceed in assessing the functionings but by focusing more on the capabilities:

- assessing the functionings means to under-use the Sen's approach. Quoting Sen: "as the so-called "budget set" in the space of the commodities represents the liberty of the person to buy a bundle of commodities, the *capability set* in the space of the functionings reflects the liberty of the person to choose among the possible lifestyle", so analysing the functionings is the same as to consider the commodities in itself and not in what they can do for the individual.
- the selected functionings, in the industrialized country, essentially depends on the income: an inadequate income is the principal cause of deprivations that we normally associate to poverty. Some of the basic functionings in industrialized countries such as being educated, enjoying a good health, having a suitable habitat basically depends on our income. If we use the achieved functionings to estimate the multidimensional poverty or the well-being in a society, we only capture the economy capacity rather than the freedom to choose between different life-styles. May be, in the middle band of income distribution, achieving a vector of functionings reflects the level of income more than a unconstrained choice between all the possible opportunities. Thus, using the functionings rather than capability, two methodologies which are conceptually very different: the income and the capability approach can overlap and coincide.
- an analysis of poverty, above all in Italy, cannot only be based on the lack of income neither on the analysis of who are the individuals and what they do (if the selected functionings are educated or not, if they have a good health or not, if they have a suitable habitat or not). The Italian situation and above all the situation concerning the south of Italy, is symbolic because it emerges, more than in the other industrialized countries, the difference between what an individual is and of what he would be able to be.

Sen's approach was introduced for developing countries thus it need to be reformulated for the industrialized ones, but it's necessary to proceed in this way as to assess "real" poverty above all for the implications of political economics that this involves. Identifying the "real" poor also means to identify the most appropriate form of politics to help them.

Thus, who are the "real" poor? According to a personal interpretation of the approach of Sen the poor are those people who didn't have the choice to not be poor, in other words, the poor are all those individuals that

don't have the possibility, the ability, the potentiality in a word the *capability*, to have a suitable income to survive on.
We can estimate the extension of this kind of poverty, by proceeding to assess the capability set.
A model that provides a framework for going beyond functionings to reach the capabilities is a model which assumes that these capabilities are unobserved latent variableswhich are observed through a set of indicators and which are influenced by a set of exogenous (or even endogenous) causes. Thus, this model is the so-called MIMIC model (the model with Multiple Indicators and Multiple Causes of a Single Latent variable): the observed variables are a manifestation of an underlying unobserved latent concept and there are other exogenous variables that cause the latent factors. Taking into consideration the example of health, we will proceed by trying to assess the capability of health using the MIMIC model.
The next section of this paper summarizes the theoretical framework of the capability approach by putting forward the case of one of the most important components of human well being: health; then, it, formally, formulates the econometric model.
In the second section, the paper tries to, briefly give a description of data and of the variable used in the estimation, then, it tries to assess the capability as a latent variable using the MIMIC. The last section of this paper ends with some concluding remarks.

1. The theoretical framework

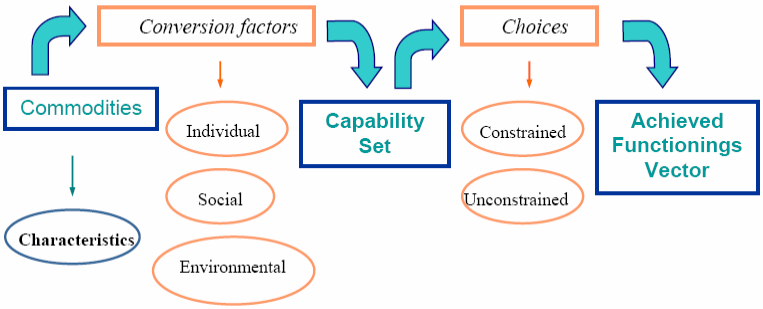
1.1 The capability approach

The earlier formulation of the capability approach took place in 1979, when, in his Tanner Lectures on "The human values", Sen proposed a wide ethic theory about equality.
In the essay "Equality of what",was drawn from those lessons, Sen explained that through the space of capabilities it was more appropriate to evaluate the inequality than both the space of utilities (Bentham) and the space of primary goods (Rawls).
In fact, the analysis of Sen starts with an explicit criticism to the three theories : the Rawls' one, the utilitarian one, and the Total Utility's one. The innovation is that Sen focuses his attention on the category of functionings that are just instrumental, mostly because it seems natural to just not look at how an individual "functions" in a certain way, but rather

at if he has the *capability* to function in that way, even if he does not choose to do so.
So, the alternative proposed by Sen was the capability approach : the possession of goods, or the utility that originated from those goods, does not provide in itself the well-being of a person. Rather, than depending on what the individual is able to do with those goods, given the intrinsic characteristics of goods, and the external circumstances. In other words, we need to focus our attention on the space of evaluation of functionings, that becomes a space of evaluation different from both the goods and the utility.
So, the capability approach becomes an alternative way to define the human behaviour, considering the well-being of a person as the liberty to live the life that we value. Sen built this approach relying on two fundamental judgements to the traditional approach: he stressed that we can not translate automatically the possession of a good into well-being and he stressed that to possess a good is something different from the capability to beneficiate from the intrinsic characteristics of the good itself. This approach elaborated by Sen seemed to settle both the questions: the translation of all the available resources into the well-being of an individual mostly depends on the individual and social characteristics, and the functionings achieved are naturally connected to those characteristics: Furthermore, if we look at the achieved functionings we can observe the choice of the individual between a lot of possible vectors of functionings: those vectors only reflect the liberty of choice made between different alternatives and the capability of doing it.
In substance, graph 1 synthesizes the capability approach: in order to illustrate synthetically the relations between a commodity and an individual, Sen takes for example a bicycle[2]: we can distinguish the commodity (the bicycle), from the characteristic (the transportation). The functioning is linked to the utilization of the characteristic and it is the action of moving with the bicycle, it is possible thanks to some conversion factors, that can be individual, social and environmental, meanwhile the capability reflects the possibility or the ability or even the freedom to move. Thus, one can have a bicycle but, because of an illness, he/she can not use it. Or one can have a bicycle but chose simply to not use it. Both persons have the same functioning but they have to be

[2]A. Sen, "Choice, Welfare and measurement" , 1982 Basil Blackwell Publisher, Oxford, pag. 29

considered in two different ways: the first one does not have the "transportion capability" meanwhile the second one simply does not have the "transportion functioning".
Thus, Sen focuses the attention on the capability to be and to do somethings even if we can choose to do not do it, or some more, he focuses on capability set: the set of all possible vectors of functionings that people can achieve. The capability is, in substance, the freedom to realize one vector of functionings between all the possible vectors that we can choose.



In this perspective, the poverty is the uncapability, thus it is not linked to the commodities but to the possibilllity of use it. The basic uncapability can contribute to premature mortality, malnutrition, illiteracy, bad health conditions, but also it can contribute to problems that they are typical for industrilized countries such as unmploiment, criminality, social esclusion.
Many economists have contributed to develop Sen's approach, there were a lot of conferences to discuss it: someone wrote to complete the capability apporach eleborating a list of basic capabilities[3], someother tried to make operationalized the apporach, using sofisticated ststistical tools (as an example the *fuzzy* set theory[4]).
Thus, in our specification of the model, the capabilities are latent, unobservable (or not well measured) and endogenous. Capabilities are influenced by a set of individual, social and institutional factors; some of

[3] See Doyal a Gough (1991), Nussbaum (1995), Deasi (1995), Alkire (1998).
[4] See Brandolini D'alessio (1998), Chiappero Martinetti (1994, 2000), Cerioli, Zani (1990) e Cheli, Lemmi (1995).

which can be influenced by them (observed endogenous factors) others can be external (exogenous causes), this structure forms our structural model. The achieved functionings are observed and measured, they are linked to the capability and constitute our qualitative response model (the measurement model).

One of the most exhaustive lists of capabilities is the Martha Nussbaum one.

The list of "Central Human Functional Capabilities" (Nussbaum 2000) shows, in ten points, the wide range of beings and doings that people may value. The second point of this list is "*Bodily Health: to have a good health, including reproductive health; to be adequately nourished; to havean adequate habitat.*" , thus, obviously, a good level of health is an important constituent of one's well-being. Sen does not provide such a list of human capabilities, but most of his examples explain his capability approach concerned with the "bodily health" capability.

Being healthy is not only an integral part of well-being but also acts as an instrument in enhancing the other capabilities, that, in turn, can also influence it. Therefore, being healthy provides us with a capacity to work, to study, to go out and have social relationships, our earnings (from work activity), for example, can also contribute to a good level of health. However people may react differently to health issue even if they face same problems, the same means and infrastructures are accessible, they live in similar areas. Sometimes the way of

reacting depends on the circumstances, sometimes it depends on direct choices that they make i.e. some may go to a public health centre, some to a private one; sometimes it simply depends on human diversity i.e. a better level of education can increase the set of opportunity because some choices are, now, well-known for example using alternative forms of medicine.

Therefore we have to stress the differences between the level of health achieved (the health functionings) from the freedom to achieve a good level of health. This concept, even strictly correlated, is very conceptually different. One can have a bad level of health because of his\her preferences by not taking care of his\her body, one can reach a bad level of health because the structure of the area in which he\she lives does not permit to take care of his\her body. The difference is crucial for the implication of political economics that involves.

So, in this paper we chose to estimate the capability of health as latent variable using the Mimic model, obviously, it can be considered only as

a simple, preliminary study. We will try, shortly, to consider jointly all the capability that constitute the human well-being to estimate it as a latent variable measured by the achieved functionings and influenced by observed endogenous and exogenous causes.

1.2 The econometric Model

The well-being has to be analysed as a latent variable measured by observed indicators, more recently in econometrics. At first the statistical tools employed were factor analysis[5] and principal components analysis[6], more recently a model with Multiple Indicators and Multiple Causes (MIMIC) was used[7]. This model allows to estimate the well being or the multidimensional poverty combining in one single step the factor analysis and the regression analysis.

The MIMIC model[8] was built by Jöreskog and Goldberger in 1975, it is a procedure for estimation of a model in which one observes multiple indicators and multiple causes of a single latent variable. This model displays a mixture of econometric and psychometric themes, it is a restriction of the general model of *Lisrel* (Linear Interdependet Structural Relationship). Lisrel started as a software[9] and became a method which was used to estimate the structural coefficient of factorial analysis using the maximum likelihood. However the application of this model has become a general procedure to estimate the statistic relationships among latent, unobservable variables and observable ones: the structural equation model (SEM). *Mimic* tries to give an answer to two kinds of questions:

1. Measuring latent variables that are whether unobservable or not properly measured
2. Estimating a causal link based on theoretical hypothesis

To do this, the *Mimic* model consists of two parts:

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[5] See, for example, Lelli(2001) that analysed individual well being in Belgium or Balestrino, Scicolone (2002) for Italy.

[6] See Klasen..???

[7] See, Di Tommaso, M.L. and Weeks, M., 2000 and Addabbo, T., Di Tommaso, M.L., Facchinetti, G., 2004, Comim F. and Kuklys W., 2002.

[8] Jöreskog, K. and Goldberger, A.S., 1975 "Estimation of a model with multiple indicators and multiple causes of a single latent variable" Journal of the American Statistical Association

[9] Powered by Jöreskog and Sorbom, 2003

1. The measurement model shows how the latent variables are estimated through the observed variables (the so-called indicators)
2. The structural model displays the casual link among the latent variables and the observed variables.

To compute the Mimic model, we can identify four steps:

1. The formulation of theoretical model: a priori we can identify the causal link among the variables and also to formulate the model
2. The estimation of parameters: we can estimate the covariance matrix, then the coefficient of the measurement and structural model as the value that minimize the difference between the matrix from raw data and who's been estimated from the model
3. The verification of the model: we can confute the model if the difference mentioned above is too high
4. The modification: on the basis of previous results we can eventually modify the model to fit better the data.

Let us now introduce some notation to formulate the theoretical framework that lead us to write in formal terms the general simultaneous equation model (SEM) and the set of equation forms the measurement model or the qualitative response model (QRM) .

In our case the specification of MIMIC model considers the latent variable η is scalar, we have a vector of exogenous variable that influenced the latent variable and a vector of exogenous indicators entering the measurement equation.

Thus,

η is the latent unobserved variable

$\boldsymbol{\gamma}$ is the vector of structural coefficient γ_i (i=1,…,k)

$\mathbf{x}$ is the vector of exogenous causes x_i (i=1,…,k) of η_i

$\boldsymbol{\lambda}$ is the vector of measurement coefficient λ_i (i=1,…,p)

$\mathbf{y}$ is the vector of observed indicators y_i (i=1,…,p) associated with η_i

$\boldsymbol{\varepsilon}$ is the vector of the disturbance error of the structural model

$\mathbf{u}$ is the vector of the disturbance error of the measurement model

We can now write down the model in formal terms as follow.

The latent variable is linear determined, subject to a disturbance ε, by a set of observable exogenous causes x_i (i=1,…,k) :

$$\eta = \gamma_1 x_1 + \ldots + \gamma_k x_k + \varepsilon$$

The latent variable determines, linearly, a set of observable endogenous indicators y_i (i=1,…,p) subject to a disturbance u_i (i=1,…,p) :

$$y_1 = \lambda_1\eta + u_1 \ , \ldots , \ y_p = \lambda_p\eta + u_p$$

Let us recall the vector as above, we can write:

$$\boldsymbol{\eta} = \boldsymbol{\gamma}'\mathbf{x} + \boldsymbol{\varepsilon} \qquad (1)$$
$$\mathbf{y} = \boldsymbol{\lambda}\boldsymbol{\eta} + \mathbf{u} \qquad (2)$$

$$E(\varepsilon u') = 0 \ , \ E(\varepsilon^2) = \sigma^2 \ , \ E(uu') = \Theta^2 \qquad (3)$$

where Θ is the m X m diagonal matrix with θ, the vector of standard deviations of the u's displayed in its diagonal.
As we stated before this model is divided into two parts: (1) is the structural equation that specifies the causal relationship between the observed exogenous causes and the latent variable, (2) is the measurement equation of the latent variable η. As we know, η is unobserved, thus we need to combine (1) and (2) to estimate the coefficient of the model. The reduced form representation is:

$$\mathbf{y} = \boldsymbol{\lambda}(\boldsymbol{\gamma}'\mathbf{x} + \boldsymbol{\varepsilon}) + \mathbf{u} = \boldsymbol{\Pi}'\mathbf{x} + \mathbf{v} \ , \qquad (4)$$

where the reduced-form coefficient matrix is

$$\boldsymbol{\Pi} = \boldsymbol{\gamma}\boldsymbol{\lambda}' \ , \qquad (5)$$

and the reduced-form disturbance vector,

$$v = \boldsymbol{\lambda}\varepsilon + u \qquad (6)$$

has covariance matrix

$$\Omega = E(vv') = E[(\boldsymbol{\lambda}\varepsilon + u)(\boldsymbol{\lambda}\varepsilon + u)'] = \sigma^2\boldsymbol{\lambda}\boldsymbol{\lambda}' + \Theta^2 \qquad (7)$$

As this model characterizes a casual relationship between a latent variable and a set of exogenous factors we can also identify the model with a graphic form representation, using the path analysis[10].

[10] The path analysis was introduced by Wright, S., 1934, "The Method of Path Coefficients" here the path coefficients are the regression coefficients

The graph below is an example of the representation of MIMIC model using the path analysis, here:

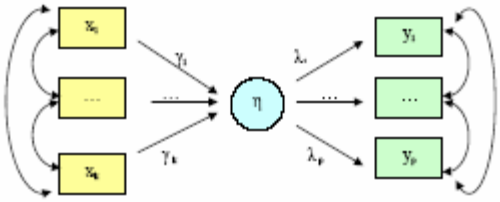
1. The representation of the variable:

- the unobserved endogenous latent variable, η, is in a circle or a ellipse form
- the observed variables (either causal variable x, and exogenous indicators y) are in a square box

2. The representation of the causal link:

- the causal link among variables are represented by unidirectional arrows, their direction imply the causality of relationship (from the independent to the dependent variable), the strength of these links is shown by the regression coefficient.
- the simple associations among variables (without any causal link) are represented by a two-way arrow, the strength of these links is shown by the correlation coefficient.

Graph 2 Path diagram of MIMIC model



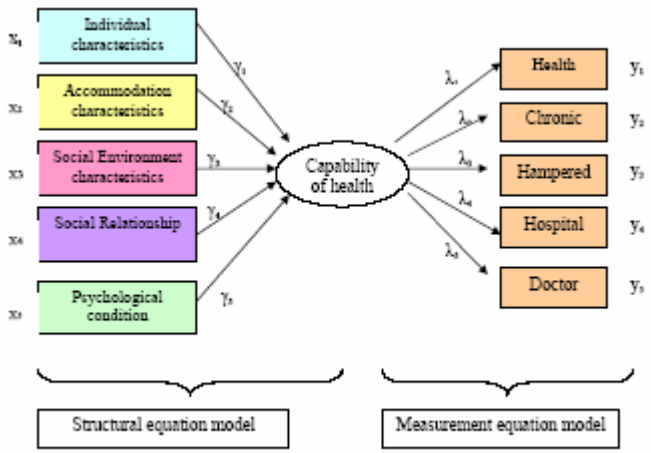
Let's formulate, now, the theoretical model, using all the instruments that we mentioned above.

The aim of this paper is to estimate the capability of health, that it is influenced by a set of exogenous causes and is measured by a set of exogenous indicators. We chose five indicators, as graph 3 shows, entering in the measurement equation, as they are defined in table 1.

We grouped all the exogenous causes in five groups, these groups of variables are well defined in table 1. First, the health status depends on age, on the level of education, on the income, and on the level of nourishment, we expected that only the first variable has a negative effect on our latent variable. The second set of variables concern the accommodation characteristics, of course, living in a well furnished

house can increase the capability of health. Thirdly we have the characteristics of social environment, as you can notice in table 1 they are all negative characteristics, so we expected that the social environment has a negative effect on the capability of health. Fourthly we have the social relationship positively correlate with the health status, and finally the so-called psychological condition[11] that concerns the level of happiness that people can achieve, six variables have been included in our analysis, they are based on an ordinal scale that show the level of satisfaction in the same six categories, all of them are expected positively to effect the capability of health.

Graph 3 Path diagram of MIMIC model for capability of health



[11] Following Martinetti (2000), she is included the psychological conditions (the subjective perception on one's own situation) in the measurement of well being, of course, these are useful also in the analysis of capability of health because they show the level of satisfaction and so the happiness of each people for their own condition.

2. Estimation issues

Using the innovative technique of MIMIC model we will try to estimate the link between some exogenous causes and the capability of health (our latent variable).
Shortly we will define all the variables considered entering in the structural and measurement equation, using the ECHP data.
We will proceed, then, with a descriptive, explorative analysis, giving you the starting point for a lively discussion later, we will able to give the estimation of MIMIC model.

2.1 Data and definition of variables

The European Community of Household Panel (ECHP) is a survey which began in 1994; the last wave was in 2001. The data was collected in eight waves in the period from 1994- to 2001 from fifteen countries. Austria, Finland and Sweden participated in the ECHP since 1995, 1996, 1997 respectively . The ECHP was stopped in 1997 in Germany, Luxembourg and the UK, but data is available from national panels. This survey is based on a standardised questionnaire that involves annual interviewing of a representative sample of household and individuals in each EU member state. It covers a wide range of topics such as income, health, education, housing, employment, and it is possible to follow up the same households over several consecutive years.
The annual ECHP survey covers more than 60.000 households and 130.000 individuals across Europe. It is the most representative European database for comparative multidimensional poverty studies. It was designed as a household panel survey that facilitates both longitudinal and cross-national analysis.
For this first analysis we only use the last wave of the panel (2001) and we selected the Italian questionnaire.
There are two major registers within ECHP, one called personal register and one called household register, in this research we chose the individual as the analysis unit because it is more appropriate when we consider the capability approach to poverty analysis, we try to combine both personal and household information that come from the two registers mentioned above.
table 1 presents the indicators for each dimension considered and it shows how the variables are created with the relative ECHP question.

Table 1: Definition of the variables

Independent variable (xi) created	ECHP questions
Individual characteristics	
Age (continuous variable)	PD003 Age of the individual
Male (dummy variable 1=male 0=female)	PD004 Sex of the individual
Income12(continuous variable)	HI100 Total net household income HD005 Equivalised size, modified-OECD scale
Schooling (ordinal variable, scale from 0 to 3=3rd level of education13)	PT022 Highest level of general or higher education completed
Nourishment (dummy variable 1=yes 0=not)	HF007 Can the household afford eating meat, chicken or fish every second day, if wanted?
Accommodation characteristics	
Crowding Index CI=1 if room>=4 CI=3 if room<=0.59 CI=2 otherwise14)	HA006 Number of rooms without kitchen HD002 Number of adults in the household (17 years or more)
Heating (dummy variable 1=yes 0=not)	HA017 Does the accommodation have lack of adequate heating facilities?
Rot (dummy variable 1=yes 0=not)	HA020 Does the accommodation have rot in window frames or floors?
Social Environment characteristics	
Pollution (dummy variable 1=yes 0=not)	HA021 Is there any pollution, grime or other environmental problem caused by traffic or industry ?
Crime (dummy variable 1=yes 0=not)	HA022 Is there crime or vandalism on the area ?
Noise (dummy variable 1=yes 0=not)	HA015 Does the accommodation have noise from neighbours or outside ?
Social Relationship	
Meeting (dummy variable 1=yes 0=not)	PR004 How often do you meet friends or relatives not living with you, whether at home or elsewhere?
Talking (dummy variable 1=yes 0=not)	PR003 How often do you talk to any of your neighbours?

[12] We use the household equivalised income, the scaling factor, by which total net income is divided, is the modified OECD equivalence scale, included in the ECHP dataset.
[13] The scale is based on the International Standard Classification of Education (ISCED, 1997)
[14] The crowding index is calculated following Martinetti (2000) and it is defined as the number of room available for each family correct by equivalent scale estimated on the basis of household food expenditure (Carbonaro 1985)

Club (dummy variable 1=yes 0=not)	PR002 Are you member of a club or organization?
Psychological condition	
Job Satisfaction (dummy variable 1=yes 0=no)	PK001 Satisfaction with work or main activity
Job Security Satisfaction (dummy variable 1=yes 0=not or not applicable)	PE032 Satisfaction with job security in present job
Financial Satisfaction (dummy variable 1=yes 0=no)	PK002 Satisfaction with financial situation
Housing Satisfaction (dummy variable 1=yes 0=no)	PK003 Satisfaction with housing situation
Leisure Satisfaction (dummy variable 1=yes 0=no)	PK004 Satisfaction with amount of leisure time
Warm Satisfaction (dummy variable 1=yes 0=not)	HF003 Can the household afford keeping your home adequately worm?
Indicators of health (yi)	ECHP questions
Health (ordinal variable, scale from 1=bad to 5=very good)	PH001 How is your health in general?
Chronic (dummy variable 1=yes 0=no)	PH002 Do you have any chronic physical or mental health problem, illness or disability?
Hospital (continuous variable)	PH007 Which is the number of nights spent in hospital during the past 12 months?
Doctor (continuous variable)	PH011 Which is the number of times have you been to a doctor or a dentist or optician?
Hampered (dummy variable 1=yes 0=no)	PH003 Are you hampered in daily activities by this physical or mental health problem, illness or disability?

2.2 Results

In table 2 we presented a descriptive statistic for each variable, whether independent or not. Most of them are dummy variable, we can explain the mean as the intensity in the sample, thus we know that the sample is characterized by 49% of men, and restricting the ordinal variable of health to just two categories (good health and bad health) we can say that 63% of people in our sample declare to have a good level of health. To confirm the self assessed health status, just, 12% of people have chronic physical or mental health problems, illness or disability, and 10% of them are hampered in daily activities by these problems. For ordinal scales, statistics such as mean and standard deviations are meaningless and therefore are not reported. For these dimensions, we have reported the correspondence dummy variable help us to synthesize the sample.

Table 2: Descriptive statistics

Independent variable (xi)	Mean	Standard Deviation	Min	Max
Individual characteristics				
Age	45,74	18,14	17	92
Male	0,49	0,50	0	1
Income	11,152	6,861	0	163,199
Schooling :				
Degree	0,09	0,27	0	1
Diploma	0,35	0,47	0	1
Less than diploma	0,56	0,49	0	1
Nourishment	0,94	0,24	0	1
Accommodation characteristics				
Crowding Index:				
Crowded	0,002	0,046	0	1
Halfcrowded	0,94	0,23	0	1
Not crowded	0,054	0,22	0	1
Heating	0,84	0,37	0	1
Rot	0,04	0,20	0	1
Social Environment characteristics				
Pollution	0,12	0,33	0	1
Crime	0,13	0,34	0	1
Noise	0,32	0,47	0	1
Social Relationship				
Meeting	0,96	0,20	0	1
Talking	0,91	0,28	0	1
Club	0,25	0,43	0	1
Psychological condition				
Job Satisfaction	0,29	0,45	0	1
Job Security	0,19	0,40	0	1
Financial Satisfac	0,15	0,36	0	1
Housing Satisfac	0,43	0,49	0	1
Leisure Satisfac	0,31	0,46	0	1
Warm Satisfac	0,79	0,41	0	1
Indicators of health (yi)				
Health :				
Good health	0,63	0,48	0	1
Bad health	0,10	0,30	0	1
Med health	0,27	0,44	0	1
Chronic	0,12	0,32	0	1
Hampered	0,10	0,30	0	1
Hospital	0,93	7,84	0	349
Doctor	7,25	7,39	0	20

Sample size: 13135 observations

In table 3 we have proceeded with a descriptive analysis given by an intersection among the five groups of variables and the state of health of the individual, we want to underline, among the poor people in health, who do not have the capability of the health. With the exception of the individual characteristics, we aggregate all the other indicators for each dimension, in this way we have four new variables: 1) quality of house, it is good if the house is not crowded, if it has heating facilities and it does no have rots; 2) quality of social environment, it is good if the area has not pollution, criminality and noise; 3) quality of social relationship, it is good if people can meet or talk with friends or relatives outside the house; 4) the overall satisfaction, it is good if people are satisfied in each dimension of psychological condition (job, accommodation, leisure, financial and warm satisfaction).

In the table, among the unhealthy people, we can interpret the underlined percentage as the people who do not have the capability of health because of individual or structural deprivations.

Results show that for each dimension being deprived means having a bad level of health. The number of healthy people are always more than 50%, we can notice that, in each dimension, it decreases when people faced some problems such as not being nourished, living in a bad house and in a bad environment, having bad social relationships and not being satisfied. In the last case, for example, the percentage of healthy people decreases of 22% in favour of unhealthy ones when these people are not satisfied.

Table 3: Percentage of people having a bad or good level of health by exogenous causes

	Bad health	Good health
Nourished	36,57	63,43
Not nourished	49,75	50,25
Good Environment	35,66	64,34
Bad Environment	40,01	53,99
Good House	33,33	65,67
Bad House	47,93	52,07
Good social relationship	36,71	63,29
Bad social relationship	42,71	57,29
Satisfied	15,97	84,03
Not satisfied	37,88	62,12

Table 4 shows the aggregation of all the dimensions in one indicator, this means that the people that are deprived lack in each dimension.
Thus, we can see that the percentage of healthy people decrease of 32% in favour of unhealthy ones when these people are deprived. In other words, we can say that being deprived (either individually than structurally) strongly influences the level of health, and more meaningful being deprived changes the relative ratio between healthy and unhealthy people, in fact the percentage of the last ones become more than 50% (53,6%) when these people are deprived. Finally, we can also interpret this results saying that, the 0,5% of unhealthy people (22 out of 4907) did not have the capability to be it.

Table 4 : Percentage of people having a bad or good level of health by deprivation index

	Bad health	Good health
Not Deprived	26 (15,2%)	144 (84,7%)
Deprived	22 (53,6%)	19 (46,4%)

The main regression results are presented in table 5 and 6[15]. We have five groups of exogenous causes and five indicators of the latent variables that we called capability of health.

We present the regression coefficients, for three different specifications of the structural equation, then the coefficients of the measurement equation for the same three specifications. We report three specifications: the first one considered the complete model with all the variables created, then we separated the subjective and the objective exogenous causes because we wanted to test separately the influence of these two components on the health status. We are able to look to some dimension both in an objective than in an subjective way of view so we try to stress, if it exists, this difference.

First of all, it is typical of SEM models to produce large values of chi square when sample sizes are large, as in the present case. Thus, the RMSEA may be a more meaningful measure of goodness of fit. The RMSEA values of our three specifications indicate that the fit of the model is reasonable[16].

The interpretation of regression coefficients is possible through the definition of the measurement coefficients.

As we showed in the reduced-form model (par. 2.1) each regression coefficient is scaled by the coefficients of measurement equation, thus, we have to say that the regression coefficients show as the observed variable influenced the latent variable proportionally to all the other indicators. As we had fixed the first indicators (health) to be equal to 1, we do not need to scale the coefficients.

Table 5 shows that , among the indicators the most meaningful is "*doctor"* (the number of times spent visiting a doctor) as it can explain the latent variable 4,5 times more than the indicators "*health"*.

[15] The appendix 1 shows the graphs for each specifications.

[16] As Browne and Cudeck (1993) suggest, an RMSEA=0,05 indicates a close fit and values up to 0,08 represent reasonable errors of approximation in the population.

Most of the coefficients in all three specifications are significant, the regression coefficients are the relative strength of the link among the observed variables and the latent one, it is important to look at this relationship but also to a proportion of variability linked to each variable.
If it is without doubt the interpretation of three variable *age*, *nourishment* and *income* on capability of health, the sign of their impact, in fact, is as we expected something we have to say on *schooling*, also because is the strongest link among the individual variables (0,04): it seems true that a good level of education can enhance the health status, probably because the education can help to chose between a huge variety of care, that sometimes are unknown for less educated people. The characteristics of social environment are, always, non significant, unfortunately we do not have a subjective variable for this group of causes. We can notice, instead, that the social relationship indicators are significant and positive correlated to the capability of the health, and these are the strongest links (0,26 for *meeting* and 0,07 for *talking*) among all the variables. In this case, we have a subjective indicator of social relationship (the leisure satisfaction) and we can notice, in the "subjective model" that it is negatively correlate with capability of health, but, perhaps, this indicator is endogenous and not exogenous in our model because the leisure satisfaction can depend on health status, differently from the others satisfaction indicators.
The indicators of the accommodation characteristics show as living in a bad house can negatively influence the capability of health, all the indicators of the quality of house can stress this relationship. If we look at the "subjective model" we can confirm this relationship because of the positive correlation between the housing satisfaction and the capability of health.
As we can notice in the "subjective model", the psychological condition can influence the capability of health, all the coefficients are significant, and positively correlate with the latent variable (except for *leisure*) thus, as we already stressed in the explorative analysis, being satisfied can enhance the capability of health.

Table 5: MIMIC model of capability of health. Regression coefficients of the structural equation (γ)

Independent variable (xi)	Specification 1	Specification 2	Specification 3
Individual characteristics			
Age	-0,01 (0,00) -35,32	-0,01 (0,00) -37,46	-0,01 (0,00) -35,94
Male	0,01 (0,01) 1,07	0,01 (0,01) 1,30	0,01** (0,01) 1,56
Schooling	0,04 (0,01) 4,83	0,04 (0,01) 5,80	0,05 (0,01) 5,94
Nourishment	-0,04 (0,02) -2,17	-0,03 (0,02) -1,50	-0,03** (0,02) -1,48
Income	0,001** (0,00) 1,72		0,001 (0,00) 3,89
Accommodation characteristics			
CI	0,05 (0,02) 2,71		0,05 (0,02) 2,88
Heating	0,06 (0,01) 4,40		0,08 (0,01) 5,91
Rot	-0,05 (0,02) -1,97		-0,05 (0,02) -2,05
Social Environment characteristics			
Pollution	-0,001 (0,01) -0,18		-0,001 (0,01) -0,25
Crime	-0,01 (0,01) -0,58		-0,01 (0,01) -0,59
Noise	-0,01 (0,01) -1,27		-0,01 (0,01) -1,25
Social Relationship			
Meeting	0,26 (0,02) 11,01		0,26 (0,02) 11,06
Talking	0,07 (0,02) 4,09		0,07 (0,02) 4,10
Club	0,02** (0,01) 1,43		0,01 (0,02) 2,32
Psychological condition			
Warm satisfact.	0,02 (0,01) 1,58	0,06 (0,01) 4,81	
Job Satisfaction	0,05 (0,01) 4,47	0,05 (0,01) 4,31	
Job security sat.	0,05 (0,01) 3,75	0,05 (0,01) 4,10	
Financial Satisf.	0,02 (0,01) 1,49	0,03 (0,01) 2,07	
Housing Satisf.	0,01 (0,01) 0,69	0,02** (0,01) 1,62	
Leisure Satisf.	-0,03 (0,01) -2,51	-0,03 (0,01) -2,50	
RMSEA	0,070	0,094	0,080

The level of significant is 0,05. ** Regression coefficients significant at 0,10.
Standard error in brackets and t-value in italics.

Table 6: Coefficients of the measurement equation (λ)

Indicators of health (y_i)	Specification 1	Specification 2	Specification 3
Health	**1**	**1**	**1**
Chronic	**-0,57** (0,01) *-80,30*	**-0,57** (0,01) *-80,30*	**-0,57** (0,01) *-80,30*
Hampered	**-0,54** (0,01) *-80,30*	**-0,54** (0,01) *-80,30*	**-0,54** (0,01) *-80,30*
Hospital	**-2,37** (0,13) *-18,16*	**-2,37** (0,13) *-18,16*	**-2,37** (0,13) *-18,16*
Doctor	**-5,40** (0,13) *-41,82*	**-5,40** (0,13) *-41,82*	**-5,40** (0,13) *-41,82*

The level of significant is 0,05. ** Regression coefficients significant at 0,10.
Standard error in brackets and t-value in italics.

Conclusion

This paper has to be considered as a first version of empirical application to the capability approach using an innovative statistical technique: the MIMIC model.

As first step, we can say that main results show that deprivation, in each dimensions considered, influences negatively the capability of health, even if healthy people are the most in the sample, the percentages of them decrease when we consider the state of deprivation.

Mimic model confirms the explorative analysis, showing a correlation between all the exogenous causes considered and the capability of health.

The model chose it seems to well fit the data, and also the specifications seem to do it.

The second aim of this work is to try to analyse all the achieved functionings jointly to estimate the well-being or the multidimensional poverty.

As Krishnakumar[17] J. has suggested the capabilities have a simultaneous nature, they, by definition, cannot be directly measured, we can measure the achieved functionings that, in MIMIC model, they became the indicators of the latent variable that we can call well-being or the capability of well-being. Each capability dimension can be explained by a set of indicators, as we tried to do before, and in turn they can be influenced by a set of exogenous and endogenous causes.

[17] Krishnakumar, J., 2004, "Going beyond the functionings to capability: an econometric model to explain and estimate capabilities", Cahiers du dèpartement d'èconomètrie no2004.12

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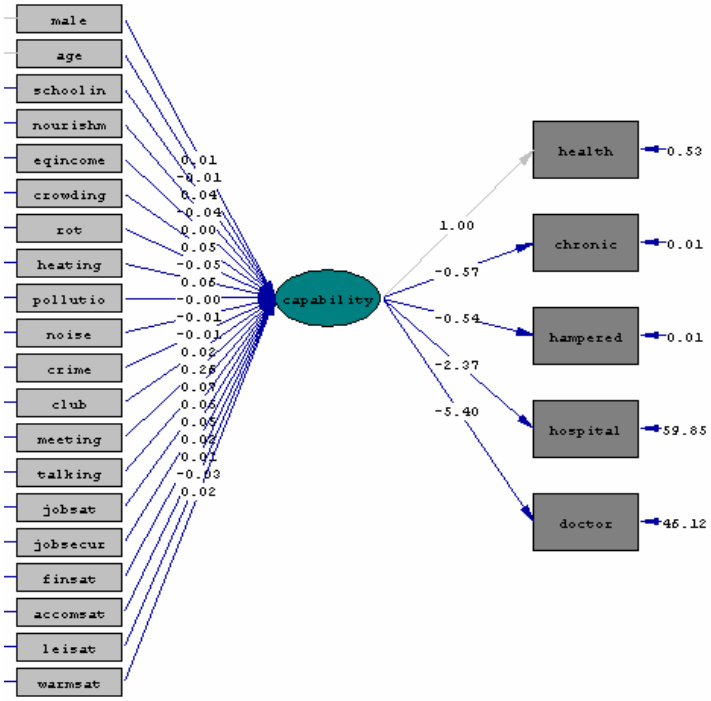
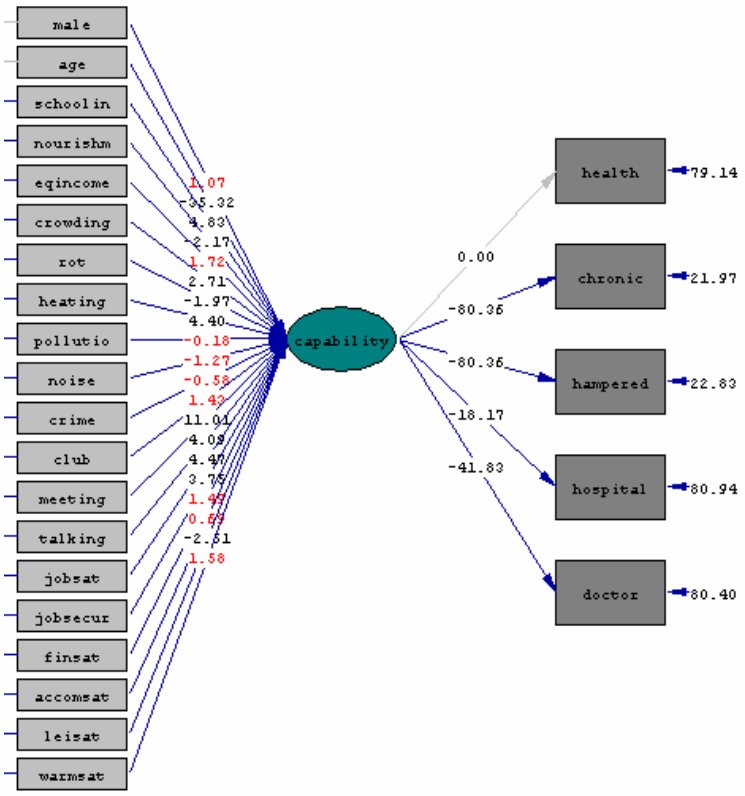
APPENDIX 1

Graph 5: Regression coefficients and t-value for the "complete model"

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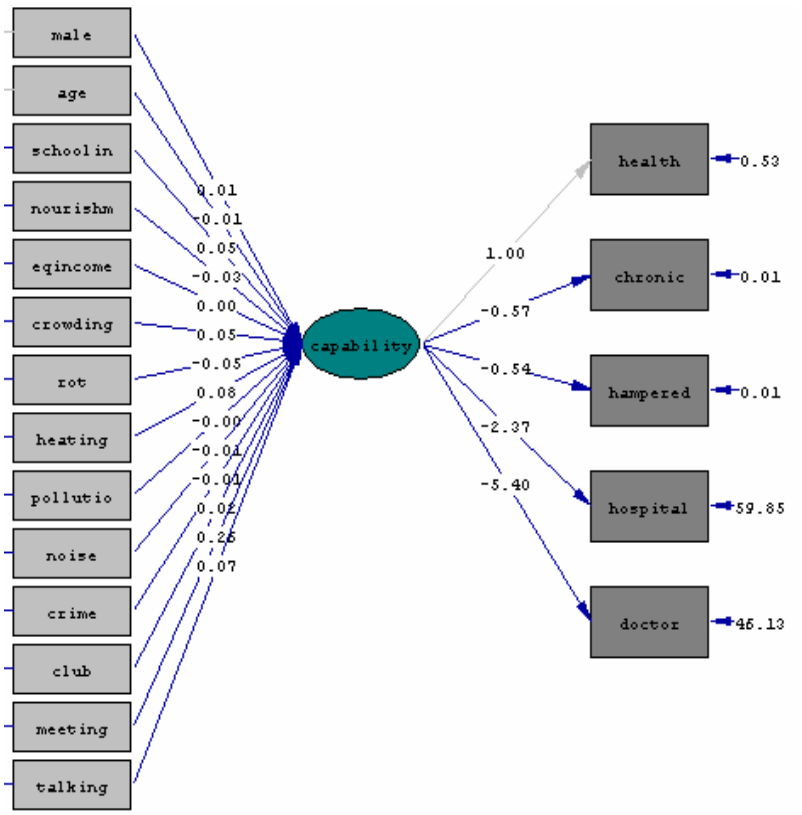
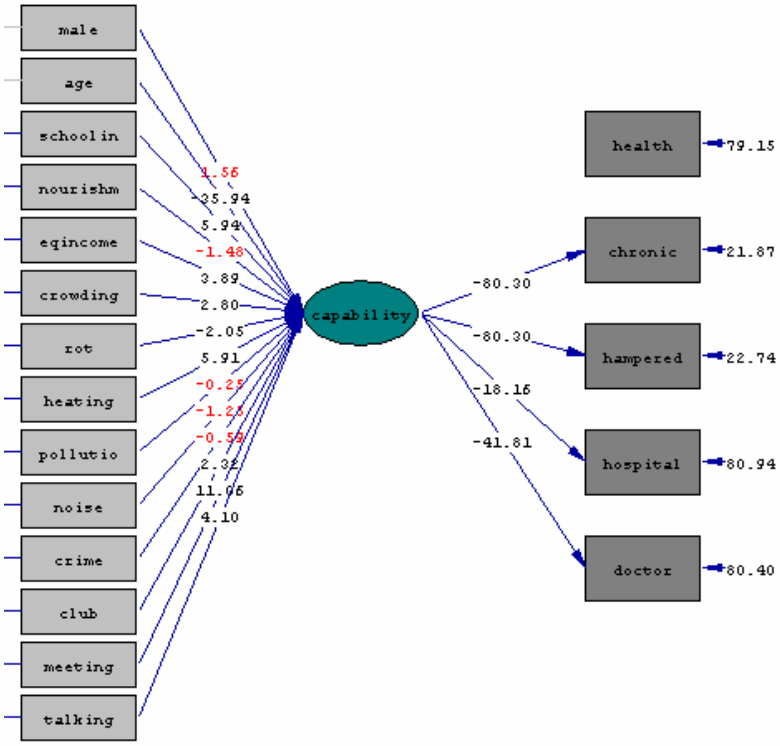
Graph 6: Regression coefficient and t-value for the “objective model”

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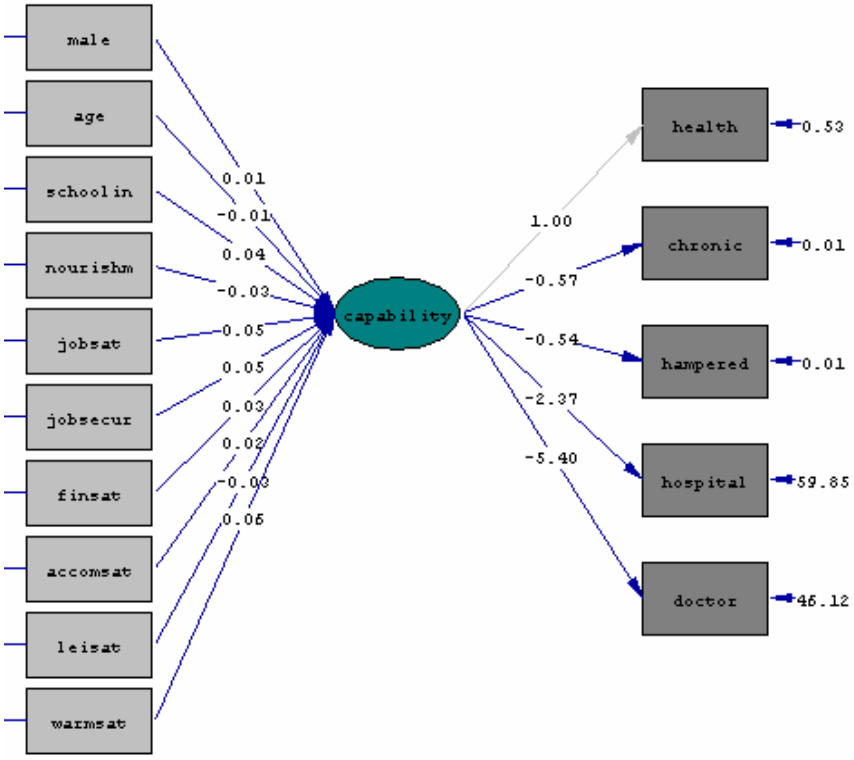
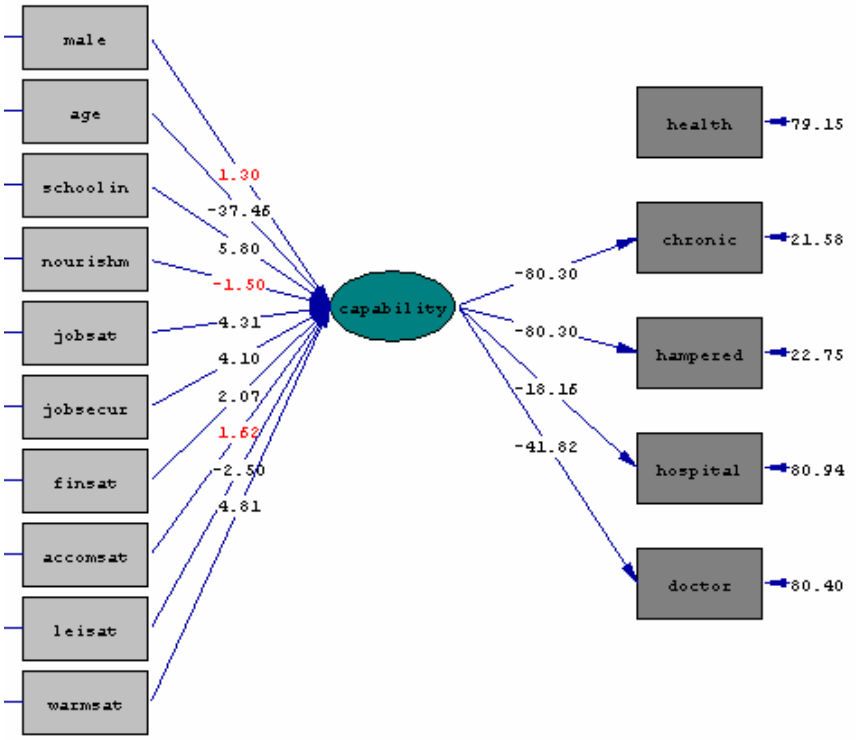
Graph 7: Regression coefficients and t-values for the “subjective model”

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