Health and Labor Force Participation in Mexico: A panel data approach

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Abstract (preliminary)

We examine the role of changes in health on participation decisions of elderly in Mexico using the Mexican Health and Aging Study (2001-2003). A simultaneous equations model accounts for potential endogeneity of health. Preliminary results with a two-stage estimation method suggest that a better health causes a stronger attachment to the labor market, and finds no evidence that employment affects health. A FIML estimation procedure is being developed, to take the correlation between the labor force participation and health equations into account in a better way.

Keywords: Labor force participation, health status, pensions, elderly, panel data
JEL-codes: J21, J14, C35

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1. Introduction

It is well-documented that Mexico has an aging population. Although aging is still in an early phase, compared to many other OECD countries, the decline of the youngest cohorts implies that in the long run the share of older people will increase drastically, despite the relatively young population at this moment (Burniaux *et al.*, 2004; Wong, 2001; Zúñiga Herrera, 2004). One of the consequences of an aging population is an increased pressure on pension plans: more people have the right to claim from the plan, while on the other hand the number of people who contribute to the plans is likely to decrease due to a decreasing labor force. Currently however the number of contributors to pension plans is relatively low, due to a large informal sector (Levy, 2008), resulting in an income situation of elderly in Mexico that is not good (e.g. Pedrero Nieto, 1999; Parker and Wong, 2001; Wong and Espinoza, 2003; Rodriguez-Flores and DeVaney, 2006). Another consequence of an aging population is that the costs for health care services are likely to increase, because in general elderly people have more health problems. The larger number of elderly is therefore likely to increase the pressure on health expenses (e.g. Ham Chande, 1999), which are paid from social security plans that are financed by working people and increasingly through tax-financed social protection (*Seguro Popular*). It implies that the younger generations have to contribute more to the social security plans in order to cover the health expenses for the older generations. This may add incentives for informality, avoiding contributions to social security (Levy, 2008).

For the long-run development in Mexico it is important to be aware of and account for the economic consequences of foreseeable demographic changes in discussions about the redesign of the social security system. However, not a lot is known about the mechanisms that govern labor force participation, retirement decisions, and health. Research in the USA, Canada, the UK, the Netherlands and other European countries indicates that changes in health status are important in labour force participation decisions and income, suggesting a positive correlation between health and income or socio-economic status (Smith, 1999; Adams *et al*., 2003). Correlation does not necessarily imply causality, because the relation can run both from health to labor force participation as well as in the opposite direction.

If the positive correlation is mainly due to causality running from health to social-economic status, then investments in a good health care system and prevention of health shocks may generate positive side-effects for the income of households; a better health care affects not only public health but also may help people to remain more productive for a longer time. However if the main causal direction is from socio-economic status towards health, policies should be focused at income redistribution and education increasing labor market opportunities. Then an improved health will follow, while direct investments in health prevention have no positive side-effects on income. If the causality is bidirectional, investments in health and in the labor market will reinforce each other.

In this paper the determinants of the labor force participation of men and women aged 50 and more years in Mexico are analyzed. In particular we study the importance of health for the participation decision, acknowledging the potential endogeneity of health. For Mexico, Parker and Wong (2001) analyze the determinants of health care coverage and of pension receipt, but explain neither health status nor participation. Aguila (2007, 2008) shows that financial considerations are important in the decision to retire or continue working. Van Gameren (2008) concludes that better health increases participation, and that there are no clear indications of a causality running in the opposite direction while he also finds that elderly who contributed to a retirement plan are more likely to withdraw from the labor market. In that paper only the first wave (held in 2001) of the Mexican Health and Aging Study (MHAS) was used, while in this paper the panel data structure of the MHAS is exploited. Further, men and women are analyzed separately now. [PM working on FIML estimations]

The outline of the paper is as follows. Section 2 discusses the framework for labor supply decisions of elderly workers, taking into account retirement options and other factors. In section 3 the data are introduced. The modeling strategy is outlined in section 4, while the analysis of the determinants of labor force participation decisions is presented in section 5. Section 6 concludes.

2. Background

Health is partly endowed at birth, but it is certainly not exogenous to individual's decisions made over the lifetime. Health can be seen as a specific type of human capital, and investments may be required to maintain or improve the 'health capital'. Investment requires resources, and therefore decisions regarding investments in health are taken jointly with decisions about investment in human capital, labor supply, and other consumption.

The issues at hand can be illustrated by Grossman's (1972) seminal model of the demand for health. In the basic formulation of the model, the lifetime utility of a consumer is given by a utility function

$$U = U(\varphi_0 H_0, \ldots, \varphi_n H_n, Z_0, \ldots, Z_n),$$

where H_t is the stock of health in time period t and $h_t=\varphi_t H_t$ is the total consumption of 'health services' while Z_t indicates the total consumption of other commodities. Agents maximize their lifetime discounted sum of utilities over healthy time and consumption subject to constraints set by

the development of their stock of health and the production of health and other commodities. The growth of the stock of health is determined by gross investments I_t and by the (exogenous) rate of depreciation δ_t,

$$H_{t+1} - H_t = I_t - \delta_t H_t.$$

The production of gross investments in health is given by

$$I_t = I_t(M_t, TH_t, E_t),$$

where M_t stands for the use of medical care, TH_t is the time input and E_t is the (exogenous) stock of human capital. The production of other commodities Z_t is described by the household production function

$$Z_t = Z_t(X_t, T_t, E_t),$$

where X_t is the input of market goods and T_t is the time input. Both market goods and time are scarcely available resources. The budget constraint of the goods equates the present value of expenses on goods to the income over the life cycle,

$$\Sigma [(P_t M_t + V_t X_t) / (1+r)^t] = A_0 + \Sigma [(W_t TW_t) / (1+r)^t],$$

where P_t and V_t are the prices of medical care M_t and market goods X_t respectively. The wage rate is given by W_t while TW_t is the time spent working and A_0 indicates the initially available assets. The interest rate is given by r. In each period t, the total available time Ω must be distributed over the possible uses,

$$TW_t + TH_t + TL_t + T_t = \Omega,$$

where TL_t is the time lost due to illness or injuries. An assumption of the model is that the sick time is inversely related to the stock of health, *i.e.* $\partial TL_t/\partial H_t<0$. The factor φ_t can be interpreted as the flow of time spent healthy per unit of H_t. Then h_t stands for the total amount of time spent healthy, and the sick time can be written as $TL_t = \Omega - h_t$. First order conditions equate the marginal benefits of health to the marginal costs, thus giving a desired health level.

The existence of temporal links between health outcome and socio-economic status in this model is obvious (Smith, 1999:148-149). A lower socio-economic status, identified by a lower wage rate W and a lower total income, reduces opportunities to buy medical care services M_t, which implicates lower gross investments in one's health, I_t. Lower socio-economic status can also be inherited from the historical backgrounds of the family, which would show up in low values of initial health stock H_0 and other assets A_0. A low value of H_0 has a direct diminishing effect on the lifetime utility U, and more investments are required to reach a similar stock of health as those who started with a better health. Lower initial assets A_0 reduce the opportunities to invest in health improvements. The level of education, and thus of human capital is another important factor, because in general a higher level of education relates to a higher socio-economic status. In the model, more human capital E_t improves the efficiency of both the production of investments in health (I_t) and of other commodities (Z_t).

The arguments above imply a causation running from socio-economic status to health, but arguments for a causation running in the other direction can be given equally well. People in a better health will loose less time due to sickness (TL_t is lower) and can spend more time working (TW_t) thus having more opportunities to acquire earnings and increase their socio-economic status. As health accumulation is a timely process, initial bad health (H_0) and episodes of bad health during some period of one's life have direct effects on income, but also negatively affects the income in later period t. Further, periods of reduced income capacities due to bad health are likely to transfer into lower income after retirement, as many pensions are at least partially based on the earlier labour income.

In our sample of persons over 50 years old we can also use the framework set by retirement decision models. Life cycle models describe the trade-off between consumption and leisure over the

remaining lifetime of a worker (Lumsdaine and Mitchell, 1999; Stock and Wise, 1990). A worker chooses his or her retirement age, the age at which he or she withdraws from the labor force, such that the expected utility over the remaining lifetime is maximized. The budget constraint of the maximization problem consists of the present values of labor and non-labor income (including pensions) as well as leisure. When the utility gained from taking leisure exceeds the utility of working one more year, the worker will decide to retire and refrain from further participation in the labor.

Retirement models identify various reasons why health status is a determinant of the optimal retirement age (Lumsdaine and Mitchell, 1999). Most arguments suggest a relation where poor health reduces the optimal retirement age and thus the labor force participation. First, poor health reduces the productivity of a worker and therefore the expected earnings, implying that work becomes less attractive in comparison with retirement. Second, job tasks are more demanding when health is weaker, changing the preferences in favor of leisure. Third, more time may be necessary to care for one's health, further increasing the utility of leisure and reducing participation. Fourth, with poor health one may be entitled for disability benefits, which enables withdrawal from the labor market. A fifth effect of poor health is a reduction of life expectancy, shortening the time horizon of the optimization problem. An anticipated negative health shock then results in a shorter work life (and also in fewer retirement years). A counter-effect that postpones retirement is that the utility of consumption may increase relative to leisure given that the costs of treatment may increase necessary expenses.

Measurement of health

Empirical analysis of the effect of health on the retirement and labor force participation decisions is hampered by measurement problems including the possibility of causality running in the opposite direction (Bound, 1991; Bound *et al*., 1999). Health is negatively affected by one's work if, for example, dangerous labor circumstances or long working hours result in the deterioration of a worker's health. A positive direct effect is also possible: a job may contribute to one's satisfaction and well-being, which may positively affect the (actual or perceived) health. Further, noting that bad health is a legitimate reason to refrain from participation, non-participants may justify their withdrawal from the labor market by overreporting health problems (known as the 'justification hypothesis', see for example Anderson and Burkhauser, 1985). Under this hypothesis, part of the (self-evaluated) health status measures a person's attitude towards work or the preference for leisure. Another measurement issue is that it may be difficult to capture all relevant health aspects in one measure. In principle, the self-assessed health measure captures all aspects because the respondent will give a general evaluation of his or her health. However, diseases and other health problems can result in a variety of physical and cognitive limitations with different implications for labor capacities, while in reporting the health status the respondent will not have only work-related aspects in mind. On the other hand, detailed reports on the (objectively observed) prevalence of diseases and symptoms that do not suffer from justification bias are necessarily incomplete.

Data that contain both (subjective) self-evaluated health and detailed (objective) information on physical and mental health status can be used to test if endogeneity due to a direct dependence on participation or due to the justification hypothesis is indeed a problem, and if the set of objective health variables gives a better description of the actual productive capacity of a worker.

Empirical evidence

In many countries social security provisions and private pension plans are found to be important determinants of the retirement behavior of the elderly. Often the regulations give strong incentives to continue working at least until a certain age while giving disincentives to continue working at older

ages. From empirical research it appears that older people have a strong preference for leisure, and it is found that workers with generous pensions tend to retire earlier (Gruber and Wise, 1999, 2004; Blundell *et al*., 2002). Explicit financial incentives to delay retirement tend to have the expected effect of postponing retirement (Lumsdaine and Mitchell, 1999; Gruber and Wise, 1999, 2004). The analyses in Gruber and Wise (2004) show that incentives set by the social security system have similarly strong effects in all the countries that they review, despite the very different cultural histories underlying the systems. For example in the USA there are peaks in retirement at ages 62 and 65 that are the consequence of the benefit schemes (Rust and Phelan, 1997). Most employees have not saved enough to retire without receiving public social security or contributions from employer-provided pension benefits. Retirement before the date at which public or private contributions start is therefore rare (Gruber and Wise, 2004).

Research specifically focused on the retirement decision in Mexico is scarce. For the majority of the elderly Mexicans the financial situation is not so generous that they can afford to stop working early. A recent contribution is Aguila (2008), who concludes that the social security reform of 1997 increased consumption while crowding out savings for low and lower-middle income earners, an effect that is stronger for people close to retirement age. Aguila (2007) concludes that also in Mexico the financial incentives are a major determinant of retirement. In general the pensions in Mexico are less generous than in European countries, and the consequential lack of financial resources can be expected to be an important explanatory factor for the high labor force participation among elderly that was shown in the previous section. Other factors such as health status may however pose restrictions on the employability of the elderly. The role of health in labor force participation and retirement decisions, and more general the link between health and socio-economic status, is not well understood (Smith, 1999; Adams *et al*., 2003). More insight is important to be able to predict the impact of policies that aim to stimulate labor force participation and improve the health of the population.

In empirical work several approaches are followed with regard to the potential endogeneity of health in the retirement or participation decision. Some studies directly apply a self-evaluated health measure (*e.g*. Rust and Phelan, 1997; Blundell *et al*., 2002) without carefully analyzing the potential endogeneity. Some studies tackled the endogeneity of self-evaluated health through instrumentation with available objective health indicators such as the prevalence of diseases, medicine usage, or functional limitations. In that case a single exogenous health indicator is included in the equation of interest, the retirement or participation decision. Some researchers find indications of endogeneity (*e.g*. Kerkhofs *et al*., 1999; Disney *et al*., 2006; Cai and Kalb, 2006; Cai, 2010), but in other cases there is no or only weak evidence that self-rated health is endogenous (*e.g*. Stern, 1989; Dwyer and Mitchell, 1999; Wolff, 2005). Dwyer and Mitchell (1999) test for the endogeneity of objective measures using parent's health and mortality and respondent's height/weight ratio as instruments, and conclude that there is no problem with endogeneity of health. Bénitez-Silva *et al*. (2004) exploit the availability in their data of both self-rated disability and the receipt of disability benefits (indicating officially, objectively approved disability), and conclude that the subjective and objective measures are sufficiently close to each other so that the hypothesis that subjective disability is an unbiased estimator of the objectively determined disability cannot be rejected. In an analysis of ten European countries Kalwij and Vermeulen (2008) find that the self-evaluated health status is endogenous in some but not all countries. They conclude that health should be included as a multidimensional factor using both subjective and objective health information, but also that the dimensions important in explaining the participation decision differ between countries.

In summary, the available empirical evidence suggests that poor health negatively affects labor force participation and leads to an earlier retirement, but the range of estimates varies widely, partly due to the variety of measures applied (Currie and Madrian, 1999). Evidence on a relation

running from participation to health is mixed. Cutler *et al*. (2000) showed that economic crises that hit Mexico in the 1980s and 1990s increased the mortality rates by a reduction in the incomes, suggesting that in Mexico a relation running from labor market status to health exists. Van Gameren (2008) suggests that for Mexicans aged 50 and over health negatively affects labor force participation, but that there is no clear evidence of an effect in the opposite direction.

3. Data

Data from the Mexican Health and Aging Study (MHAS, in Spanish *Encuesta Nacional sobre Salud y Envejecimiento en México* (ENASEM); Puig *et al*., 2006; Wong et al., 2007). MHAS is organized as a panel survey, where the baseline survey (held in 2001) is constructed as a nationally representative sample of the about 13 million Mexicans aged 50 and over. The questionnaire contains questions about socio-demographic status (including information on children living outside the household), health status, functional limitations, use of health services and other sources of support, current and previous labor status, sources of income and properties.[1]

Changes in the sources and amount of income can be linked with changes in the health status of the sampled elderly. Information on workplace conditions is not available, but the sector in which the employee was active during the major part of his work life and the type of job are known. Both self-reported health condition and objective measurements are available, and also information on the childhood health and living conditions and the parental education is available.

Both the heads of the selected households as well as their partners were interviewed, resulting in a total sample size in 2001 of 15,186 individuals. In the follow-up survey of 2003, attempts where made to interview the same age-eligible persons and their household members, even if the household had moved or split. Some could not be traced or refused to participate (5.8% of the targeted households) while others died in the two years between the interview and a next-of-kin was interviewed (3.8% of the interviewed individuals) (Wong and Espinosa, 2004).

In the analysis we focus on the households that did not face a change in composition due to divorce or death. Such major changes in household composition are likely to dominate other decisions. Dropping observations with incomplete information on essential variables (in particular, employment and health[2]) leaves us with 10,106 individuals with information both in 2001 and 2003. Table 1 shows that more than half of the sample, 56.1%, is female. In 2001, 65.6% of the sampled elderly were younger than 65 years, a percentage that dropped to 58.9% in 2003. These percentages hardly differ between men and women.

Table 1 Number of observations, by gender and age, 2001 and 2003

gender	age (2001)		age (2003)		total	%
	50-64	65 or more	50-64	65 or more		
men	2 816	1 620	2 530	1 906	4 436	43.9
women	3 817	1 853	3 425	2 245	5 670	56.1
total	6 633	3 473	5 955	4 151	10 106	100
%	65.6	34.4	58.9	41.1	100	

Labor force participation

In the analysis we focus on the extensive margin, thus on the decision whether someone participates in the labor market or not. The employment status is derived from the question regarding the

[1] The set up and the available information are highly similar to surveys such as the Health and Retirement Study (HRS) in the USA, the English Longitudinal Survey on Ageing (ELSA) in the UK and the Survey of Health, Ageing and Retirement in Europe (SHARE) in 11 continental European countries.

[2] Incomplete information on detailed health characteristics is recoded as the absence of the problem at hand. Observations where the detailed health information is completely missing in one or both years are excluded from the analysis.

activities in the week before the interview. We include also people over 65 years old; other than in many countries there is no mandatory retirement at age 65 in Mexico and people are observed to continue working after they reach that age.

Table 2 shows the labor force participation by age and self-assessed health. Around 80% of the men between 50 and 65 years old are working, a percentage that drops to just below 50% for men above 65 years. Only in the group with poor health the percentage of working men is much lower, although there seems to be a positive trend of increasing participation with better health. Overall, participation rates are much higher than in European countries (Kalwij and Vermeulen, 2008; OECD, 2006). Participation rates among elderly women are much lower than among men. Even in the group of women aged 50-65, only 30% reports to be working. A large share of women dedicate themselves to household chores and are not considered as labor market participants. Among the women aged over 65, about 13% reports to be working. Also among women increased participation seems to go with a better health status.

Table 2 Health and labor force participation by age and gender, 2001 and 2003[a]

		poor	fair	good	very good/excellent	total
			2001			
males						
	50 – 64	62.7	80.3	85.6	85.8	80.9
	65 or more	39.6	48.5	55.7	55.8	49.3
females						
	50 – 64	24.7	26.6	35.4	41.2	29.5
	65 or more	11.5	12.2	14.3	23.9	12.9
			2003			
males						
	50 – 64	65.6	78.8	83.3	89.9	79.6
	65 or more	30.8	47.1	55.2	58.3	46.1
females						
	50 – 64	23.9	28.2	36.6	39.4	30.1
	65 or more	9.5	13.7	15.3	21.3	13.2

a Each cell contains the percentage of people in the age/health combination that is observed to be economically active.

Health status

The MHAS asks for a self-evaluated, subjective, health condition and contains objective information based on observations by medical personnel. Self-assessed health is measured by the question about the respondent's general health: "Would you say your health is...", with five possible answers: excellent, very good, good, fair or poor. Nothing is mentioned about the reference group that a respondent should keep in mind. The average reported in table 3 is between fair and good health, with a slightly better health for men, and a small decrease of health between 2001 and 2003.

The objective health information is collected via a large set of questions regarding specific health problems (see table 3). The level of specificity and concreteness of the questions and concepts leaves much less room for a subjective answer than is the case with the question regarding the general health status. The survey of 2001 asks whether hypertension, diabetes, cancer, respiratory problems, heart problems, stroke, and arthritis have ever occurred, that is whether a doctor or other medical personnel has ever told the respondent that he or she suffered from the disease at hand. For liver or kidney infections, tuberculosis and pneumonia, and for the other diseases in 2003, it is asked if in the two years before the survey a doctor or other medical personnel has told the respondent that he or she had the problem. Further we use the questions whether the respondent has fallen down in the last two years (with or without breaking bones), has mental problems or problems with daily

activities,[3] suffers from overweight, or has some symptoms that indicate a less healthy situation.

Table 3 Descriptive statistics of health problems

	2001		2003	
	male	*female*	*male*	*female*
Subjective health				
self-assessed health	1.389	1.185	1.285	1.123
Diseases				
hypertension/high blood pressure	0.293	0.459	0.290	0.432
diabetes/high blood sugar level	0.135	0.176	0.152	0.187
cancer/malignant tumor	0.009	0.027	0.007	0.008
respiratory illness (e.g. asthma)	0.058	0.066	0.045	0.046
heart attack	0.039	0.027	0.023	0.023
stroke	0.025	0.022	0.009	0.011
arthritis/rheumatism	0.155	0.255	0.139	0.231
liver/kidney infection	0.083	0.119	0.071	0.091
tuberculosis	0.003	0.004	0.003	0.002
pneumonia	0.013	0.017	0.009	0.014
fallen down	0.275	0.437	0.286	0.442
mental health problems	2.918	3.998	3.100	4.133
problems with (i)adl	2.694	4.140	2.757	4.110
Overweight				
bmi between 25 and 30	0.374	0.270	0.353	0.247
body mass index 30 or higher	0.170	0.198	0.167	0.182
Symptoms				
swollen feet/ankles	0.193	0.346	0.179	0.329
difficulty breathing	0.130	0.157	0.128	0.158
fainting spells, vertigo	0.171	0.298	0.183	0.303
intense thirst	0.161	0.184	0.148	0.177
severe fatigue/exhaustion	0.226	0.307	0.218	0.295
wheezing/cough/phlegm	0.182	0.181	0.176	0.184
pain in lower limbs	0.361	0.492	0.367	0.481
stomach pain, indigestion	0.170	0.223	0.175	0.227
involuntary loss of urine	0.079	0.092	0.092	0.089

Note: All indicators (except the first one and the final two) are dummy variables (where 1 indicates the existence of the problem). Mental health is measured on a scale from 0 to 9, and (i)adl ranges from 0 to 22, where a higher score indicates more severe problems. The scale for self-assessed health ranges from poor (0) to excellent (4).

Other variables

In section 5 the labor force participation is analyzed by linking it with the health situation of the respondents, and with the age, household composition, level of education, and the financial situation (table 4). About 83% of the sampled elderly men are married or live in a consensual union. The average age of these men is 62 years (in 2001) and they have on average 5.9 children. Almost 60% are living in cities with 100,000 or more inhabitants. They average female in the sample has the same age as the men, but less than 60% reports to be married.

About three out of four elderly in the sample have none or only primary education. We obtain more variation in the education by the inclusion of variables that indicate if the respondents are able to read and write and can count, and they are able to speak English or an indigenous language. We include the total net value of real estate, investments, savings, stocks, shares and

[3] The nine questions about the mental health ("did you feel depressed?", "did you feel happy?", "did you feel lonely?", etc.) are combined into one measure of mental health status. Similarly the questions about the performance of functional activities and activities of daily living consider problems such as limitations with walking, sitting, climbing stairs, stretching the arms, lifting objects, bathing, getting in and out of the bed, using the toilet, shopping, or preparing food are combined into a single measure. In both cases the number of mental health problems and the number of activities on which the respondent reports a problem, respectively, are counted. A higher value indicates a larger the intensity of the mental problems and the limitations.

bonds, and private mean of transport as an indicator of the wealth of the elderly.[4] The expectation is that the possession of more assets may enable elderly to withdraw from the labor market. The variable indicating access to social security includes the elderly's rights due to their own (current or earlier) labor efforts, but also rights derived from working family members (partner, children). More than 60% of the respondents has access to the services provided by social security.

For the identification of the participation equation (see next section), we use information on the main job that was held by the respondent throughout his or her life, which tells us something about the work history of the respondent: we know the type of occupation (based on INEGI's Mexican Classification of Occupations) and the type of contract. The most common occupations among men are manufacturing ((industrial) production, repair, maintenance (39%), and work in the agricultural sector (28%). Among women, the larger share does not have a history of paid work (32%), followed in size by services (workers in the service industry and domestic service workers: 23%). Working for a salary was the most common situation throughout their life for 58% of the male respondents and 40% of the female respondents, while 29% of the men and 17% of the women used to be in self-employment. Self-employment and occupations in the agricultural sector or as a domestic worker are more likely to be arranged informally without access to social security and retirements pensions. Another indicator of the sector of employment is if someone ever deposited money into a retirement pension. For elderly under 65 years old, participation in a retirement fund is likely to increase the probability to be employed at the moment of the survey, due to a minimum duration of participation as a requirement for future pension claims. For elderly aged 65 or more, previous contributions may have created the possibility to become a claimant and thus are likely to reduce labor force participation. Note that among the male elderly a much larger fraction has made contributions than among women.

Table 4 Descriptive statistics of individual characteristics

	2001		2003	
	male	*female*	*male*	*female*
age (years)	62.1	61.5	64.1	63.5
married/living together[a]	0.837	0.585	0.818	0.555
#children (live births)	5.9	6.1	5.9	6.1
education[a]				
none	0.213	0.267	0.213	0.267
primary	0.552	0.538	0.552	0.538
secondary	0.076	0.052	0.076	0.052
technical/commercial	0.029	0.082	0.029	0.082
preparatory or higher	0.129	0.061	0.129	0.061
other human capital indicators[a]				
able to read and write	0.853	0.776	0.853	0.776
able to count from 1 to 10	0.945	0.918	0.945	0.918
able to speak English	0.112	0.060	0.112	0.060
able to speak indigenous language	0.082	0.062	0.082	0.062
urbanization[a]				
locality size: >100000	0.571	0.607	0.571	0.607
locality size: 15000-100000	0.153	0.153	0.153	0.153
locality size: 2500-15000	0.092	0.089	0.092	0.089
locality size: <2500	0.184	0.150	0.184	0.150
social security				
has access to social security	0.613	0.642	0.642	0.675
Assets				
non-business assets (*$1mln)	0.334	0.301	0.426	0.373
deposited into retirement fund[a]				
contributed, age <60, <=10 yrs	0.054	0.032	0.054	0.032

[4] The net value of business ownership is not included in the wealth measure. Although the elderly can sell the business and stop working, it is also a direct motivator to continue working. Inclusion of business ownership would make the role of assets difficult to interpret.

contributed, age <60, 10<=25 yrs	0.098	0.031	0.098	0.031
contributed, age <60, >25 yrs	0.078	0.025	0.078	0.025
contributed, age 60-65, <=10 yrs	0.015	0.006	0.015	0.006
contributed, age 60-65,10<=25 yrs	0.023	0.008	0.023	0.008
contributed, age 60-65, >25 yrs	0.040	0.010	0.040	0.010
contributed, age >=65, <=10 yrs	0.034	0.008	0.034	0.008
contributed, age >=65, 10<=25 yrs	0.043	0.007	0.043	0.007
contributed, age >=65, >25 yrs	0.081	0.011	0.081	0.011
type of occupation[a]				
production, repair, maintenance	0.387	0.125	0.387	0.125
agriculture	0.276	0.065	0.276	0.065
proff.,technic.,educat.	0.089	0.068	0.089	0.068
management position	0.022	0.007	0.022	0.007
administrative activities	0.054	0.062	0.054	0.062
merchants, sales representative	0.081	0.120	0.081	0.120
service industry, domestic work	0.080	0.231	0.080	0.231
other	0.007	0.001	0.007	0.001
type of contract[a]				
employee, fixed salary	0.579	0.399	0.579	0.399
boss	0.044	0.015	0.044	0.015
self-employed	0.290	0.166	0.290	0.166
commission, other paym	0.073	0.047	0.073	0.047
without payment	0.005	0.046	0.005	0.046
other/unknown	0.006	0.006	0.006	0.006

a Dummy variable(s)

4. Methodology

Causal effects between labor force participation and health status for elderly in Mexico can be analyzed through developing a structural model. In particular it is possible to construct a variable that represents each individual's 'health stock', stripped of subjectivity and endogeneity, and use that as a proxy for health in a model for the participation decision. To construct the health stock, an auxiliary regression of the self-assessed measure on the set of objective health measures and on the other personal characteristics is performed. A similar strategy can be followed to account for the potential endogeneity of labor force participation when explaining the level of health. The constructed health stock and propensity of participation can be used as explanatory variables in the structural equations. Such constructions using cross-section data are applied by *e.g.* Stern (1989), Bound *et al*. (1999), Campolieti (2002) and Cai and Kalb (2006) while extensions toward multiple time period models using panel data can be found in Disney *et al*. (2006) and Cai (2010).

Disney *et al*. (2006) constructs a "health stock" for eight waves of the British Household Panel Survey separately and uses time variation in these individual health stocks as an explanatory variable in the (reduced form fixed effect) models of labor market (in)activity. They find evidence that health deteriorations lead to a greater chance of transition into economic inactivity. Potential causality running in the opposite direction is not addressed in their estimations. Cai (2010) uses four waves of the Household, Income and Labour Dynamics in Australia (HILDA) Survey and applies a panel data simultaneous equations model consisting of probits and ordered probits, similar to the cross-section models used by e.g. Stern (1989) and Cai & Kalb (2006). He applies both a two-stage method (cf. Stern, 1989) as well as a full-information maximum likelihood method and explicitly allows for causal relations in both directions, thus from health to work and vice versa.[5] Intuitively, in

[5] Cai (2010) includes marital status, children and age to identify the employment equation, while information on smoking, drinking, physical activities and the prevalence of a long-term health condition identify the health equation. Demography, education, job history, occupational and spousal information are included in both equations. His preferred instruments in the health equation, specific and objective health indicators such as symptoms, types and severity of disability or health conditions as, were not available. Using health and living circumstances during childhood as instruments has the drawback that, apart from having the (desired) effect on health in later years,

the first stage a health stock and a propensity of participation are constructed, which get included in the second stage structural equations.

Set-up of the model

The analytical model to analyze the causal effects of health and labor force participation is based on Stern (1989) and extended to a panel data context as in Cai (2010). Assume that for each individual i participation in year t, P_{it}, can be described as a function of the true health status H_{it}^{**}, a set of individual characteristics x_{it} such as age, gender, etc., and a disturbance term:

$$P_{it}^{*} = \lambda_P H_{it}^{**} + \beta_P x_{P,it} + u_{P,it}, \quad (1)$$

where P_{it}^{*} is an unobserved (latent) variable that represents the propensity that an elderly person participates in the labor force in period t, while P_{it} equals 1 if $P_{it}^{*}>0$, and zero otherwise. The parameter λ_P measures the (causal) effect of health on the participation decision.

The equation that describes the true but unobservable health H_{it}^{**} is given as:

$$H_{it}^{**} = \alpha_H P_{it}^{*} + \beta_H x_{H,it} + u_{H,it}. \quad (2)$$

Health depends on individual characteristics $x_{H,it}$ and on the (latent) propensity to work P_{it}^{*}. The parameter α_H represents the (causal) effect of labor force participation on the true health. The effect could be negative (*e.g.* because of bad labor conditions) or positive (*e.g.* due to increased satisfaction). We observe subjective, self-assessed health H_{it}, measured on a four-point scale. Let H_{it}^{*} be the continuous latent counterpart of the observed self-assessed health, and assume $H_{it}=k$ (k=0, ..., 3) when $m_k<H_{it}^{*}\leq m_{k+1}$ (m_k are unknown cut-off points to be estimated along with the other parameters while $m_0=-\infty$ and $m_4=\infty$). If non-participants justify their non-participation by exaggerating the self-assessed health problems, there will be a difference between the true and the self-assessed health,

$$H_{it}^{**} = H_{it}^{*} - \delta_J P_{it}^{*} - u_{J,it}, \quad (3)$$

where the parameter δ_J will has a positive value: justification implies that participating elderly (with a larger value of P_{it}^{*}) report a better health status (H_{it}^{*}) than they have in reality (H_{it}^{**}).

Substitution of the relation between true and self-assessed health in the participation equation yields the labor force participation equation that forms the basis of the empirical work:

$$P_{it}^{*} = \lambda_P^{1} H_{it}^{*} + \beta_P^{1} x_{P,it} + v_{P,it}, \quad (4)$$

where $\lambda_P^{1}=\lambda_P/(1+\lambda_P\delta_J)$, $\beta_P^{1}=\beta_P/(1+\lambda_P\delta_J)$, and $v_{P,it}=(u_{P,it}-\lambda_P u_{J,it})/(1+\lambda_P\delta_J)$. Substitution of the relation in the true health equation gives the empirical model for H_{it}^{*}:

$$H_{it}^{*} = \alpha_H^{1} P_{it}^{*} + \beta_H x_{H,it} + v_{H,it}, \quad (5)$$

where $\alpha_H^{1}=\alpha_H+\delta_J$ and $v_{H,it}=u_{H,it}+u_{J,it}$. We have panel data to our avail, which enables us to decompose the disturbance terms $v_{m,it}$ ($m=P$, H) in an individual part that is independent of time, and a time-varying part, $v_{m,it}=\varepsilon_{m,i}+\eta_{m,it}$, and apply panel data methods.

Equations (4) and (5) link labor force participation and self-assessed health to each other. Only the sum of the two sources of endogeneity, α_H^{1}, is identifiable, but whether the endogeneity occurs because participation directly affects the true health status (α_H) or is due to justification of the labor status (δ_J) is not identifiable. However the sign of α_H^{1} can give useful information about which type of endogeneity dominates.

Estimation strategy

[PM I am working on a FIML model; for the moment the two-stage method is used, assuming ρ=0. Preliminary results of a single-period FIML are shown in the appendix]

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it is also likely to have a direct effect on education and via that human capital formation, wages and labor market outcomes (Currie and Madrian, 1999).

The joint estimation of the simultaneous equations model formed by the labor force participation (eq. 4) and health status (eq. 5) is not straightforward, due to the qualitative nature of the dependent variables. The observed self-assessed health H_{it} is measured on a four-point scale, and assuming that the disturbances are normally distributed, equation (5) is essentially a panel ordered probit model, while equation (4) is a panel probit model. Panel models of this type have not been estimated frequently. A notable exception is Cai (2010), he estimates both a two-stage version of the model as well as a full-information maximum likelihood (FIML) method. Two-stage estimation is consistent, but FIML is theoretically preferred as it allows accounting for the correlation ρ between the disturbance terms $v_{P,it}$ and $v_{H,it}$ while in the two-stage method the correlation cannot be estimated and is therefore assumed to equal zero. However FIML requires evaluation of a multidimensional integral of a multivariate normal distribution function.[6]

In the first stage, reduced forms of both the participation equation and health equation are estimated. A panel probit model is used to estimate a reduced form model of participation including all variables in $x_{P,it}$ and $x_{H,it}$,

$$P_{it}^{*} = (\beta_P^{1} x_{P,it} + \lambda_P^{1}\beta_H x_{H,it}) / (1-\alpha_H^{1}\lambda_P^{1}) + v_{P,it}^{*} = \zeta_P x_{it} + v_{P,it}^{*}, \qquad (6)$$

where x_{it} contains all the exogenous variables in $x_{P,it}$ and $x_{H,it}$ and where the disturbance term can be decomposed in a time-constant and a time varying part, $v_{P,it}^{*}=\theta_{P,i}+\omega_{P,it}$ with $\theta_{P,i}=(\varepsilon_{P,i}^{1}+\lambda_P^{1}\varepsilon_{H,i}^{1})/(1-\alpha_H^{1}\lambda_P^{1})$ and $\omega_{P,it}=(\eta_{P,it}^{1}+\lambda_P^{1}\eta_{H,it}^{1})/(1-\alpha_H^{1}\lambda_P^{1})$. Similarly a reduced-form health equation is estimated,

$$H_{it}^{*} = (\alpha_H^{1}\beta_P^{1} x_{P,it} + \beta_H x_{H,it}) / (1-\alpha_H^{1}\lambda_P^{1}) + v_{H,it}^{*} = \zeta_H x_{it} + v_{H,it}^{*}, \qquad (7)$$

where $v_{H,it}^{*}=\theta_{H,i}+\omega_{H,it}$ with $\theta_{H,i}=(\alpha_H^{1}\varepsilon_{P,i}^{1}+\varepsilon_{H,i}^{1})/(1-\alpha_H^{1}\lambda_P^{1})$ and $\omega_{H,it}=(\alpha_H^{1}\eta_{P,it}^{1}+\eta_{H,it}^{1})/(1-\alpha_H^{1}\lambda_P^{1})$, using a panel ordered probit model. The results from those estimations are used to calculate the propensity to participate in the labor market $\hat{P}_{it}$ and the 'health stock' $\hat{H}_{it}$ of each individual i in each time period t:

$$\hat{P}_{it} = \hat{\zeta}_P x_{it}, \qquad (8)$$

$$\hat{H}_{it} = \hat{\zeta}_H x_{it}. \qquad (9)$$

In the second stage structural model defined by equations (4) and (5) is estimated, where the predictions $\hat{H}_{it}$ and $\hat{P}_{it}$ replace the potentially endogenous explanatory variables H_{it}^{*} and P_{it}^{*}:

$$P_{it}^{*} = \lambda_P^{1}\hat{H}_{it} + \beta_P^{1} x_{P,it} + v_{P,it}, \qquad (10)$$

$$H_{it}^{*} = \alpha_H^{1}\hat{P}_{it} + \beta_H x_{H,it} + v_{H,it}. \qquad (11)$$

For equation (10) a panel probit model with P_{it} as dependent variable can be used. Equation (4) with H_{it} as the dependent variable can be estimated by panel ordered probit model. Self-evaluated health is endogenous in the participation decision if the fact whether one participates or not has an effect on the reported health. The null hypothesis for exogeneity therefore is H_0:(α_H^{1}=0, ρ=0), which under the assumption that ρ is equal to zero breaks down to a test of the significance of α_H^{1} in equation (4). Both models include individual-specific random effects. Standard errors are bootstrapped, to account for the predicted variables.

5. Results

Table 5 presents the estimation results of the (second stage of the) structural (causal) model outlined

[6] Estimations of the cross-sectional model as proposed by Stern (1989) are more frequent, but also usually apply the two-stage method. Applications of FIML using maximum simulated likelihood (MSL) are found in Cai and Kalb (2006) for cross-section data and in Cai (2010) for panel data. Cai and Kalb (2006) find an insignificant correlation for men and a significantly negative value for women. The latter implies a bias towards zero in the effect of health on participation if the model does not account for correlation (Stern, 1989; Cai and Kalb, 2006). [PM Preliminary results in a one-period FIML suggest we have a small but significantly negative value for ρ]

in the previous section, for men and for women separately.[7] The effect of health on labor force participation is significantly positive only for men; elderly men with a better (perceived) health are more likely to be employed than men with a weaker health. For elderly women we do not find a significant effect, female labor force participation decisions appear not to be related to their health status. The analysis includes all sampled people aged over 50, thus including those who never had a paid job. Especially among women a large share never had a paid job, and the participation decision at older age is probably governed by choices that have been made much earlier in life. We see that women who are married or living together are much less likely to work, and that the more children they have the less likely it is that they are employed. These variables have no contribution at all to the explanation of participation of male elderly.

The effect of previous deposits in pension plans varies greatly between men and women, which obviously relates to the differences in labor histories. The older the men who made deposits in pension plans are, and the longer the duration of the contributions, the lower the probability that they are still in employment. Obviously the older they are and the longer they contributed, the more likely it is that they fulfill the requirements to obtain the benefit and have the financial capacities to stop working. Among women, the number of those who never worked –and thus never contributed to any pension plan– is much larger than among men. Therefore we find a strong positive effect on participation for women who ever made contributions to a pension plan and are younger than 65 years, especially if they have contributed between 10 and 25 years. With more years in the labor market and with contributions to a pension plan, they can qualify for a (better) retirement pension.

Both for men and women the variable that indicates access to social security services, either due to one's own work or pension or due to working relatives, has a strong negative effect on the participation decision.[8] Empirical evidence from the USA suggests that individuals who rely on their current employer for health insurance have an incentive to remain employed, while individuals with other sources of health insurance have less reasons to participate in the labor market (Currie and Madrian, 1999; Gruber and Madrian, 2002). The negative effect of access due to others (partner, children) on participation is a strong effect among Mexican elderly because many more elderly than in the USA are entitled to insurance through their partner or children.

The general health status is explained by the objective health characteristics, age and poverty indicators. Older men and women report to be less healthy, while elderly with more education report a better health status. Households who possess more assets are in a better health while elderly living in rural areas are less healthy. Neither for men nor women we find an effect of labor force participation on the health status, confirming the hypothesis that health can be considered as an exogenous variable (H_0:α_h^1=0). The conclusion that health causes participation but that participation does not cause health, thus that a better health situation enables elderly to remain active in the labor market, is in line with findings of many others (see section 2).

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[7] In the first-stage regressions, in both equations a test of the significance of the identifying variables strongly rejects the hypothesis that they are jointly zero, thus they correlate highly with the potential endogenous variable which fulfills one requirement to be considered valid instruments. The other requirement is that the excluded variables should not correlate with the error term of the equation. Some of the objective health characteristics, in particular an earlier stroke, hypertension, diabetes, or having functional limitations, are significant in the labor force participation equation (similar as in *e.g.* Stern, 1989). Overidentification tests (Lee, 1992) indicate that they do not satisfy the exclusion restrictions, and therefore we drop the involved diseases and symptoms from the analysis. We follow the literature and present the results of second-stage estimations using the valid objective characteristics to create one general measure for the health stock ($\hat{H}_{it}$). For the construction of the labor force participation index $\hat{P}_{it}$ there are no indications that the exclusion restrictions do not hold.

[8] Access to social security is suspect to be endogenous, as the access may be obtained due to one's own job; however the indicator used here includes access obtained due to the partner's or children's job, and participation includes formal and informal employment where the latter does not give access rights. The total set of instruments passes the overidentification tests, indicating their validity and suggesting no direct effect of access rights on health. The parameter estimates, in particular the effects of health and participation, only show minor changes if only access due to working relatives is included in the model.

Table 5 Causal model for participation and health

	men						*women*					
	LFP			health			LFP			health		
health (lin.pred.)	0.404	***	(0.042)				0.055		(0.038)			
labor force part. (lin.pred.)				-0.019		(0.036)				0,012		(0.019)
age	-0.070		(0.048)	-0.074	***	(0.028)	-0.012		(0.037)	-0,066	***	(0.022)
age squared	-0.013		(0.037)	0.047	**	(0.020)	-0.036		(0.029)	0,043	***	(0.017)
#children (live births)	0.000		(0.008)	-0.001		(0.006)	-0.028	***	(0.009)	-0,010	*	(0.006)
couple	0.030		(0.077)	-0.148	**	(0.059)	-0.433	***	(0.063)	-0,077	**	(0.038)
educ.: primary	-0.093		(0.096)	0.134	**	(0.058)	-0.264	***	(0.084)	0,052		(0.057)
educ.: secondary	-0.263	*	(0.146)	0.310	***	(0.090)	0.204		(0.140)	0,296	***	(0.094)
educ.: technical/commercial	-0.595	***	(0.211)	0.507	***	(0.134)	-0.014		(0.138)	0,432	***	(0.087)
educ.: preparatory or higher	-0.079		(0.167)	0.667	***	(0.086)	0.133		(0.187)	0,607	***	(0.089)
able to read and write	0.057		(0.113)	-0.108		(0.081)	0.145		(0.116)	-0,046		(0.059)
able to count from 1 to 10	0.106		(0.131)	-0.023		(0.097)	0.205		(0.129)	-0,002		(0.076)
speaks English	-0.139		(0.099)	0.159	***	(0.061)	-0.003		(0.114)	0,255	***	(0.070)
speaks indigenous language	0.008		(0.101)	0.148	*	(0.076)	0.001		(0.117)	0,103		(0.064)
locality size: 15000-100000	0.100		(0.088)	-0.169	***	(0.051)	0.119		(0.084)	-0,057		(0.046)
locality size: 2500-15000	0.232	**	(0.107)	-0.123		(0.079)	0.269	***	(0.100)	-0,109	*	(0.061)
locality size: <2500	0.386	***	(0.102)	-0.184	***	(0.056)	0.058		(0.092)	-0,212	***	(0.052)
non-business assets (*$1mln)	-0.018		(0.038)	0.073	**	(0.036)	-0.045		(0.052)	0,074	*	(0.039)
has access to social security	-0.186	***	(0.068)				-0.341	***	(0.055)			
contributed, age <60, <=10 yrs	-0.018		(0.144)				0.701	***	(0.153)			
contributed, age <60, 10<=25 yrs	0.115		(0.129)				1.217	***	(0.168)			
contributed, age <60, >25 yrs	-0.338	***	(0.127)				1.076	***	(0.193)			
contributed, age 60-65, <=10 yrs	-0.280		(0.214)				0.572	*	(0.333)			
contributed, age 60-65,10<=25 yrs	-0.531	***	(0.201)				1.011	***	(0.292)			
contributed, age 60-65, >25 yrs	-0.657	***	(0.136)				0.409	*	(0.244)			
contributed, age >=65, <=10 yrs	-0.364	***	(0.138)				0.369		(0.331)			
contributed, age >=65, 10<=25 yrs	-0.342	**	(0.151)				0.116		(0.337)			
contributed, age >=65, >25 yrs	-0.739	***	(0.134)				-0.321		(0.282)			
occ.: production, repair, maintenance	1.882	**	(0.852)				1.240	***	(0.110)			
occ.: agriculture	2.067	**	(0.869)				0.999	***	(0.148)			
occ.: professional, technical, education	1.961	**	(0.877)				0.952	***	(0.161)			
occ.: management position	2.180	**	(0.878)				1.647	***	(0.281)			
occ.: administrative activities	1.747	**	(0.891)				0.804	***	(0.149)			
occ.: merchants, sales representative	2.340	***	(0.866)				1.762	***	(0.117)			
occ.: service industry, domestic work	2.175	**	(0.858)				1.250	***	(0.093)			
occ.: other	1.607	*	(0.870)				1.259		(3.725)			
contr.: boss	0.516	***	(0.176)				1.109	***	(0.224)			
contr.: self-employed	0.502	***	(0.073)				0.875	***	(0.086)			
contr.: commission, other payment	0.040		(0.114)				0.488	***	(0.115)			
contr.: without payment	0.330		(0.427)				0.133		(0.129)			
contr.: other/unknown	0.239		(0.425)				0.009		(0.484)			
dis.: cancer/malignant tumor				-0.630	*	(0.323)				-0,180		(0.170)
dis.: respiratory ill.(asthma)				-0.410	***	(0.093)				-0,152		(0.103)
dis.: heart attack				-0.580	***	(0.132)				-0,438	***	(0.154)
dis.: arthritis/rheumatism				-0.241	***	(0.063)				-0,283	***	(0.052)
dis.: liver/kidney infection				-0.245	**	(0.096)				-0,252	***	(0.074)
dis.: pneumonia				-0.232		(0.258)				-0,090		(0.223)
dis.: fallen down				-0.089		(0.054)				-0,114	**	(0.049)
dis.: #mental health problems				-0.129	***	(0.014)				-0,134	***	(0.009)
overweight: 25<=bmi<30				0.056		(0.057)				0,119	**	(0.054)
overweight: 30<=bmi				0.037		(0.067)				-0,026		(0.035)
sympt: swollen feet/ankles				-0.194	***	(0.065)				-0,171	***	(0.056)
sympt: difficulty breathing				-0.102		(0.081)				-0,119	*	(0.071)
sympt: fainting spells.vertigo				-0.148	**	(0.070)				-0,220	***	(0.054)
sympt: intense thirst				-0.064		(0.062)				-0,118	*	(0.067)
sympt: sev.fatigue/exhaustion				-0.247	***	(0.064)				-0,167	***	(0.056)
sympt: wheezing/cough/phlegm				-0.019		(0.058)				-0,072		(0.062)
sympt: pain in lower limbs				-0.321	***	(0.061)				-0,251	***	(0.048)
sympt: stomach pain. indigest.				-0.122	*	(0.068)				-0,103	**	(0.046)

sympt: involunt. loss of urine				-0.242	***	(0.092)				-0,116		(0.081)
constant	5.347	***	(1.768)				0.225		(1.212)			
cut-off point 1				-5.103	***	(1.043)				-4,782	***	(0.743)
cut-off point 2				-3.255	***	(1.031)				-2,685	***	(0.733)
cut-off point 3				-1.550		(1.022)				-0,951		(0.729)
rho	0.610	***	(0.021)	0.240	***	(0.012)	0.625	***	(0.015)	0,272	***	(0.011)
#observations	8872			8872			11340			11340		
Chi2 Test	1190.4			895.1			1244.8			1477.7		
p-value Chi2	0.000			0.000			0.000			0.000		
LogLikelihood	-4248.0			-8952.0			-4616.6			-10681.9		

* p<0.10, ** p<0.05, *** p<0.01

Note: Standard errors obtained via bootstrapping (100 draws)

6. Conclusions

[PM]

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Appendix. FIML in one-period model

Table A present a FIML model for one year (2001), a FIML version of the model estimated in Van Gameren (2008) in two steps (with some minor changes in the variables used in the estimation). The effects for the effect of health on labor force participation, and of participation on health, remain largely the same as found before. The parameter rho, the correlation between the errors terms of the two equations, which is assumed to equal zero in the two-step models, is estimated to equal -0.199, a significant negative value. Extension to FIML thus improves the estimations.

[PM Working on a FIML model for panel data (the results in table 5 are obtained in two steps)]

Table A Causal FIML model, 2001

	labor		health	
health	0.270***	(0.017)		
labor			0.014	(0.021)
age	-0.037**	(0.019)	-0.051***	(0.013)
age squared (*100)	-0.006	(0.014)	0.038***	(0.010)
gender: female	-1.291***	(0.034)	0.020	(0.040)
#children (live births)	-0.004	(0.004)	-0.006**	(0.003)
married/living together	-0.270***	(0.032)	-0.093***	(0.026)
educ.: primary	-0.150***	(0.044)	0.098***	(0.035)
educ.: secondary	-0.148**	(0.069)	0.289***	(0.052)
educ.: technical/commercial	-0.172**	(0.077)	0.340***	(0.055)
educ.: preparatory or higher	-0.069	(0.077)	0.472***	(0.050)
able to read and write	0.060	(0.051)	-0.048	(0.040)
able to count from 1 to 10	0.189***	(0.063)	-0.026	(0.047)
speaks English	-0.122**	(0.050)	0.193***	(0.038)
speaks indigenous language	-0.022	(0.052)	0.097**	(0.039)
locality size: 15000-100000	0.077**	(0.039)	-0.147***	(0.029)
locality size: 2500-15000	0.093*	(0.050)	-0.188***	(0.038)
locality size: <2500	0.128***	(0.046)	-0.275***	(0.032)
non-business assets (*$1mln)	-0.088***	(0.023)	0.103***	(0.017)
<65; deposits in pension fund	0.559***	(0.053)		
>=65; deposits in pension fund	0.059	(0.066)		
#years w/ pension fund deposit	-0.007***	(0.002)		
occ.: agriculture	0.315***	(0.047)		
occ.: proff.,technic.,educat.	0.322***	(0.065)		
occ.: management position	0.525***	(0.104)		
occ.: administrative activ.	0.242***	(0.062)		
occ.: merchants, sales repr.	0.706***	(0.048)		
occ.: service ind.,domest.w.	0.417***	(0.039)		
occ.: other	-0.149	(0.216)		
contr.: boss	0.809***	(0.079)		
contr.: self-employed	0.758***	(0.036)		
contr.: commission, other paym	0.392***	(0.055)		
contr.: without payment	0.366***	(0.081)		
contr.: other/unknown	0.302*	(0.170)		
hypertens./high blood pressure			-0.218***	(0.022)
diabetes/high blood sugar lev.			-0.521***	(0.030)
cancer/malignant tumor			-0.120	(0.074)
respiratory illn. (eg asthma)			-0.345***	(0.043)
heart attack			-0.334***	(0.058)
stroke			-0.208***	(0.068)
arthritis/rheumatism			-0.211***	(0.026)
liver/kidney infection			-0.201***	(0.034)
tuberculosis			-0.056	(0.174)
pneumonia			-0.112	(0.085)
fallen down			-0.063***	(0.022)
#mental health probl. (max.9)			-0.124***	(0.004)
#problems with (i)adl (max.22)			-0.080***	(0.003)
Constant	3.263***	(0.605)	0.151	(0.480)
cut-off point 1			-3.823***	(0.152)
cut-off point 2			-2.094***	(0.152)
cut-off point 3			-0.592***	(0.154)
cut-off point 4			0.036	(0.155)
rho	-0.199***	(0.028)		
#observations	12363			
LogLikelihood	-18211.65			
Chi2 Test	3267.052***	(0.000)		

* p<0.10, ** p<0.05, *** p<0.01