LABOR FORCE PARTICIPATION OF MEXICAN ELDERLY: THE IMPORTANCE OF HEALTH*

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Resumen: Se analizan los factores determinantes de la participación en la fuerza de trabajo de la población mexicana de 50 años o más, con datos de la *Encuesta nacional sobre salud y envejecimiento en México*, ENASEM. Se estudió en particular la importancia de la salud en la decisión sobre la participación, tomando en cuenta la endogeneidad potencial de la salud. Los resultados indican que una mejor salud causa un mayor apego al mercado laboral. No se encontró evidencia clara de que el empleo afecte la salud, pero no puede descartarse que los efectos de las malas condiciones laborales y la justificación se eliminen mutuamente. Existen indicadores de que la autoevaluación de la salud no captura todos los aspectos relevantes de la salud. En la toma de decisiones para establecer políticas, la importancia directa de las circunstancias financieras podría ser más relevante que el papel de la salud.

Abstract: The determinants of the labor force participation of people in Mexico aged 50 and over are analyzed using data of the Mexican Health and Aging Study (MHAS). In particular we study the importance of health in the participation decision, taking into account the potential endogeneity of health. The results indicate that a better health causes a stronger attachment to the labor market. We find no clear evidence that employment affects health, but it cannot be ruled out that the effects of bad labor circumstances and justification eliminate each other. There are indications that self-assessed health does not capture all relevant aspects of health. For policy decisions the direct importance of financial circumstances could be more relevant than the role of health.

Clasificación JEL: J21, J14, C35

Palabras clave: labor force participation, health status, pensions, elderly, participación laboral, estado de salud, pensiones, adultos mayores

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1. Introduction

Similar to other OECD countries, Mexico has an aging population. In many European countries the process is already directly reflected in the share of the oldest cohorts, while in Mexico aging is still in its early stages, reflected by a major decline in the size of the youngest age cohorts (Burniaux, Duval and Jaumotte, 2004; Wong, 2001; Zúñiga Herrera, 2004). Despite the relatively young population, the decline of the youngest cohorts implies that in the long run the share of older people will increase drastically.

Insight into the factors that determine the labor force participation decisions of elderly workers therefore becomes increasingly important. Financial incentives allowing (early) retirement are often found to be an important determinant of the decision at hand, but in Mexico the pensions are less generous than in most European countries. Because of a lack of financial resources, elderly are more likely to continue working. Other factors such as the health may however pose restrictions on the employability of the elderly. The role of health in labor force participation and retirement decisions, and more generally the link between health and socio-economic status, is not well understood (Smith, 1999; Adams *et al.*, 2003) but is important to predict the impact of policies that aim to stimulate labor force participation and improve the health of the population. One reason why the relation between labor and health is not clearly understood is the difficulty involved in measuring the health status. Another is that health may be an endogenous variable in the explanation of labor force participation: there may be a causality running in the opposite direction, from work to health.

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 measurement issue and the potential endogeneity of health. Research on this question has frequently been performed for the USA and European countries, but in a developing economy like Mexico the relation between work and health may be different because variations in institutions governing the labor market generate differences in opportunities. We analyze the role of health in the labor force participation decision using the first wave of the Mexican Health and Aging Study (MHAS), a survey held in 2001 representative for the Mexican population aged 50 and over. 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 including tests of the endogeneity and mismeasurement of health are presented in section 5. Section 6 concludes.

2. Theoretical Framework

Given the focus on the attachment of persons over 50 years old to the labor market, retirement decision models form the theoretical background for the empirical analysis. The framework of the analysis is defined by the life cycle model describing 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.

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, Meghir, and Smith, 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).

For the majority of the elderly Mexicans the financial situation is not so generous that they can afford to stop working early. The

largest pension funds are the IMSS for the private sector and ISSSTE for the employees in the public sector, but few of the elderly effectively receive pension benefits. In 1996 only 30.5% of the men over 60 years received a pension, while among women pensions due to their own labor career were even scarcer, only 14.8% (Parker and Wong, 2001). Like health insurance and social security, pensions are job-related and only available for workers in formal jobs. Access to pensions is further restricted because a minimum duration of contributions is required and transfers between funds are limited. The replacement rate, i.e. the pension as a percentage of the pre-retirement earnings, varies with the number of contributed years and the earlier wage earnings but is typically below 50% (Duval, 2003). More than in European countries or the US, a lack of resources forces continuation of the labor force participation beyond the official retirement age of 65.

In retirement models health status is recognized as a potential determinant of the optimal retirement age (Lumsdaine and Mitchell, 1999). Poorer health can reduce the productivity of a worker and therefore reduce earnings, thus bringing down the optimal retirement age. Job tasks may be more demanding when one has a weaker health, therefore changing the preferences in favor of leisure. More time may be necessary to care for one's health, further increasing the utility of leisure and thus reducing participation. Poor health may lead to entitlement for disability benefits, which would reduce labor force participation. All these factors contribute to an earlier retirement. A counter-effect is that the utility of consumption may increase relative to leisure given that the costs of treatment may increase necessary expenses. This would postpone retirement. Another effect of poor health is a reduced life expectancy, which shortens the time horizon of the optimization problem. An anticipated negative health shock results in a shorter work life and in fewer retirement years. The overall theoretical effect of health on retirement age is ambiguous, but most arguments point towards a relation where poor health lowers the retirement age and reduces labor force participation.

2.1. *Measurement of Health*

Empirical analysis of the effect of health on labor force participation is hampered by complications regarding the measurement of health status. Often a self-evaluated health status is available in surveys, through a question that asks respondents whether they consider their own health status as good or bad. Several problems with self-

evaluated health exist (Bound, 1991; Bound it et al., 1999). The variable is suspected to be endogenous with respect to the participation decision. Because bad health is a legitimate reason for working-age people to abstain from participation, people may justify their withdrawal from the labor market by overreporting their health problems (see *e.g.* Anderson and Burkhauser, 1985). This is referred to as the 'justification hypothesis', and it causes self-evaluated health to be linked to a person's attitude towards work or the preference for leisure and does not necessarily capture the actual productive capacity. Another reason for endogeneity of health is that it can be affected by one's work, for example, if labor circumstances are dangerous or working hours so long that having a job results in the deterioration of a worker's health. A positive direct effect is also possible, being active in the labor market may contribute to one's satisfaction and thereby also to (actual or perceived) well-being. For that reason the self-rated health may not be independent of the labor market decisions, and the explanatory power of health found in a participation equation may be spurious. Another concern is that it can be questioned whether one self-evaluated measure can capture all the dimensions of health. Diseases and other health problems can result in a variety of physical and cognitive limitations with different implications for labor capacities. Even if endogeneity due to reverse causality is not a problem, the self-assessed health may be incapable of capturing all dimensions, implying a measurement error problem.

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.

2.2. *Empirical Evidence*

International 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). Findings indicate that health may be a more important determinant of wages and labor force participation in less developed countries than in more developed countries (Currie and Madrian, 1999).

Some studies directly apply a self-evaluated health measure (*e.g.* Rust and Phelan, 1997; Blundell, Meghir, and Smith, 2002) with-

out carefully analyzing the potential endogeneity. The endogeneity problem can be tackled by instrumenting self-evaluated health using 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. Findings are mixed, some researchers find indications of endogeneity (*e.g.* Kerkhofs, Lindeboom, and Theeuwes, 1999; Disney, Emmerson and Wakefield, 2006; Cai and Kalb, 2006), 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) also 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 of endogeneity of health. Following a different approach, exploiting the availability in the data set of both self-rated disability and the receipt of disability benefits (indicating officially, objectively approved disability), Bénitez-Silva *et al.* (2004) conclude that the subjective and objective measures are sufficiently close to each other and that therefore 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 (2007) find that the (one-dimensional) self-evaluated health status should be considered as endogenous in some but not all countries. They conclude that health should be included as a multidimensional factor, but also that the dimensions important in explaining the participation decision differ between the countries.

To summarize, in general a negative effect of health on participation is found, while evidence that participation affects health is mixed. Cutler *et al.* (2000) showed that the economic crises that hit Mexico in the 1980s and 1990s increased the mortality rates by reducing incomes, suggesting that in Mexico a relation running from labor market status to health exists.

3. Data: The Case of Mexico

The data used in this paper are from the Mexican Health and Aging Study (MHAS, in Spanish *Encuesta nacional sobre salud y envejecimiento en México* (ENASEM); Puig, Pagan y Soldo, 2006). 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 ques-

tions about socio-demographic status (including information on children living outside the household), health status, functional limitations, use of health services and other sources of help, current and past labor status, sources of income and properties. Only the baseline survey is used in this paper. Thus we work with a cross-section of elderly.[1]

Both the heads of the selected households as well as their partners were interviewed, resulting in a total sample size of 15,186 individuals. Excluded from the analysis are (2,907) people who answered negatively to an initial question if they ever worked for income or profits. For them, the attachment to the labor market can be considered so weak that it is likely that current decisions are based on different grounds than choices made by people who have experience in the labor market. Furthermore, 1,264 observations on partners younger than 50 are not considered in the analysis. Dropping some cases with incomplete information on essential variables leaves us with a final set of 10,183 observations that is used for the analysis.

3.1. *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 activities in the week before the interview. If the respondent indicated that he or she worked during that week (52.2%), or did not work but had a job (1.9%), the respondent is classified as a participant in the labor market. Also those who reported to be looking for a job (0.5%) are considered as participants; searching for a job means that they actively participate in the labor market and have not yet decided to retire.[2] Those who dedicated themselves to household chores (24.6%) are classified as non-participants, as are the people who answered not to be working (20.8%).

Table 1 shows the labor force participation by age. Around 70% of those in their early fifties are working, a percentage that drops to

[1] The set up and the available information are highly similar to surveys such as the Health and Retirement Study (HRS) in the US, 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] Counting the latter as non-participants has only a minor impact on the results due to the small size of the group.

53% for people in their early sixties. The latter percentage is much larger than in European countries, where about 38% of the men and 23% of the women aged 60-64 are working (Kalwij and Vermeulen, 2007; OECD, 2006). The official retirement age in most European countries is 65, but early retirement schemes often enable to stop working at a younger age. After the age of 65, very few people choose to continue working. The highest percentage of working people aged over 65 reported for western European countries is 10.1% in Sweden (OECD, 2006). For Mexico the same source reports a participation rate of 29.2% for people aged 65 and over. Therefore it is reasonable to include also the older elderly in our analysis instead of restricting it to people aged between 50 and 65. In our sample we observe that 18% of the respondents aged 80 or over report to be working.[3]

3.2. *Health Status*

The MHAS asks for a self-evaluated, subjective, health assessment and contains objective information based on observations by medical personnel as well. 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. This could be an important source of measurement error as some respondents may compare their health with earlier stages in life or with younger persons, while others may refer to people who have a similar age as themselves.

[3] For readability we write 'working', however the numbers indicate that they are economically active or are looking for work. Differences in definitions of participation cause differences in the participation rate between the OECD-source and our numbers. With our definition we stay as close as possible to the active population. In particular our definition captures the people working in the informal sector. As an alternative we could have used the survey question that asks if the respondent had a principal job during the year before the survey. The question clearly refers to having a (paid) job elsewhere, as it is posed after questions regarding one's own business or farm. If we use that variable, the participation rate would drop from 54.6% to 30.6%. Participation of people aged 65-80 (17%) and over 80 (7%) remains sizable, but probably this measure does not capture all the people who work for money. Also we do not use the question on retirement benefits; receiving benefits does not imply retirement as it is possible for the recipient to remain active in another (formal or informal) occupation.

The objective health information is collected via a large set of questions regarding specific health problems (see table 2). These questions are also answered by the respondent, but 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. Detailed information about the prevalence of hypertension, diabetes, cancer, respiratory problems, heart problems, stroke, and arthritis is asked. We use the information on whether the disease or symptoms 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 it is asked whether 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 question whether the respondent has fallen down in the last two years (with or without breaking bones).

Table 1
Labor force participation by age and gender

	Participation (%)			*Sample size*
	Total	*Men*	*Women*	(%)
Full sample				
50 or more	54.6	70.2	35.4	100
Per age group				
50 - 54	70.7	90.1	49.0	26.9
55 - 59	64.7	83.6	42.3	21.6
60 - 64	53.0	70.8	32.3	17.0
65 - 69	45.3	59.9	25.0	13.3
70 - 74	39.1	51.4	20.4	9.3
75 - 79	30.0	38.0	17.5	6.6
80 or more	18.5	24.6	10.9	5.3
Sample size (%)	100	55.3	44.7	(10,183 obs.)

A Mokken scale analysis (Mokken, 1971) indicates that the nine questions about the mental health ("did you feel depressed?", "did you feel happy?", "did you feel lonely?", etc.) all measure the same

underlying concept and can be combined into one measure of mental health status. 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. A Mokken scale analysis indicates that the 22 items describe the same underlying factor, which implies that a count of the number of activities (items) on which the respondent reports a problem can be considered a good indicator of the intensity of problems associated with the performance of (instrumental) activities of daily living ((i)adl in the table below).

Table 2
Descriptive statistics of health problems

	Mean	*St. dev.*
self-assessed health (0=poor, 4=excellent)	1.31	0.86
hypertens./high blood pressure	0.360	0.480
diabetes/high blood sugar lev.	0.154	0.361
cancer/malignant tumor	0.017	0.131
respiratory illn. (eg asthma)	0.063	0.242
heart attack	0.034	0.182
stroke	0.025	0.157
arthritis/rheumatism	0.197	0.398
liver/kidney infection (in last 2 yrs)	0.101	0.302
tuberculosis (in last 2 yrs)	0.003	0.057
pneumonia (in last 2 yrs)	0.014	0.119
fallen down (in last 2 yrs)	0.357	0.479
# mental health probl. (max.9)	3.46	2.66
# problems with (i)adl (max.22)	3.58	4.13

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) –opposite to the order in the survey– such that a higher value is associated with a better health.

3.3. *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 3). Slightly less than half of the sample is female, even though Mexico is no exception to the common observation that women live longer and thus constitute more than half of the elderly population. The underrepresentation of women in our sample is caused by the selection of elderly who reported that they have ever worked for income or profits: more women than men have never life worked for income or profits. About 70% of the sampled elderly report to be married or living together in a consensual union, and on average the number of children born to the elderly equals 5.8. More than 60% of the sample live in cities with 100,000 or more inhabitants.

The potential wage rate, often used as a predictor in labor force participation models, is excluded from our empirical analysis. Current wage rates are only observable for people who are working. Potential wages can be predicted for those who are not working, using variables such as the age and the level of education. We prefer direct inclusion of these variables in our model explaining the participation decision. About three out of four of the elderly in the sample have none or only primary education. In order to have more variation in the education, and to capture additional courses or on-the-job training, we include variables that indicate if the respondents are able to read and write and can count. Further we have information if the respondents are able to speak English or an indigenous language (not necessarily as their primary language). The survey contains information on the assets owned by the household. We include the total net value of real estate, investments, savings, stocks, shares and bonds, and private means 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.

We also have information on the main job that was held by the respondent throughout his or her life, thus on the work history of the respondent. In particular we know the type of occupation (based on INEGI's Mexican Classification of Occupations) and the type of

[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.

contract. The most common occupations are manufacturing ((industrial) production, repair, maintenance: 29%), work in the agricultural sector (20%) and services (workers in the service industry and domestic service workers: 19%). Working for a salary was the most common situation throughout their life for almost 60% of the respondents, while more than a quarter used to be self-employed. Self-employment and/or an occupation in the agricultural sector or as a domestic worker are more likely to be arranged informally. Informal sector jobs do not give access to retirement pensions, and are thus expected to raise the probability of remaining active in the labor market at old age. Another indicator of the sector of employment is if someone ever deposited money into a retirement pension. For elderly under 65 years old, having participated in a retirement fund is likely to increase the probability of being employed at the moment of the survey because a minimum duration or even participation at the age of 65 (the official retirement age) may be a requirement for future claims from the fund. For elderly aged 65 or more, previous contributions may have created the possibility of becoming a claimant and thus are likely to reduce labor force participation. Note that among the younger elderly a larger fraction (36.5%) has contributed to a retirement pension than among the older generation (30.1%). On average the elderly contributed slightly more than 7 years, which is far lower than their (likely) number of years of labor market activities, indicating that informal jobs must have been a common experience.

Table 3

Descriptive statistics of individual characteristics

	Mean	*St. dev.*
age (years)	61.9	9.4
female[a]	0.447	0.497
married/living together[a]	0.694	0.461
# children (live births)	5.8	3.6
Education[a]		
none	0.239	0.426
primary	0.516	0.500
secondary	0.070	0.255

Table 3
(*continued*)

	Mean	*St. dev.*
Education[a]		
technical/commercial	0.062	0.242
preparatory or higher	0.113	0.317
Other human capital indicators[a]		
able to read and write	0.822	0.382
able to count from 1 to 10	0.937	0.242
able to speak English	0.099	0.299
able to speak indigenous language	0.077	0.266
Urbanization[a]		
locality size: >100000	0.609	0.488
locality size: 15000-100000	0.149	0.356
locality size: 2500-15000	0.085	0.279
locality size: <2500	0.158	0.364
Assets		
non-business assets (*$1mln)	0.329	0.636
Deposited into retirement fund[a]		
among elderly under 65[a]	0.365	0.482
among elderly over 65[a]	0.301	0.459
number of years with deposits	7.3	12.6
Type of occupation[a]		
production, repair, maint.	0.290	0.454
agriculture	0.197	0.398
proff., technic., educat.	0.095	0.293
management position	0.018	0.133
administrative activ.	0.072	0.258
merchants, sales repr.	0.129	0.335
service ind., domest. w.	0.194	0.395
other	0.005	0.071

Table 3
(*continued*)

	Mean	*St. dev.*
Type of contract[a]		
employee, fixed salary	0.579	0.494
boss	0.036	0.187
self-employed	0.272	0.445
commission, other paym	0.071	0.256
without payment	0.035	0.185
other/unknown	0.007	0.081

Note: a = dummy variable(s).

4. Methodology

Our intention is to analyze the role of health in labor force participation decisions by Mexican elderly. Subjective and objective evaluations of the health status are available to us, but both have its drawbacks. In the self-evaluated (subjective) health measure the respondent can weight all aspects of health, and therefore it is expected to capture all attributes considered relevant by the respondent, but it potentially suffers from endogeneity and measurement error, as addressed in Section 2. At the same time it is not clear that the more detailed, objective, indicators summarized in Section 3 provide a better measurement of the productive capacities. Using this set of indicators assumes that the (in)activity is related to the specific health descriptions, but - despite the level of detail - the set of characteristics is inherently incomplete and possibly does not capture the full range of relevant health dimensions.

A natural strategy in the search for a causal effect is to build a structural model and use both subjective and objective health information. 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 (Stern, 1989; Bound *et al.*, 1999; Campolieti, 2002; Cai and Kalb, 2006; Disney, Emmerson and Wakefield, 2006).

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. The model is outlined more precisely here, before we discuss the results in section 5.

4.1. *Set-up of the Model*

The central issue of the paper is the effect of health on the labor force participation. Participation can be described as a function of the true health status H_i^{**}, a set of individual characteristics x_i such as age, gender, etc., and a set of work history characteristics (z_{iP}) uniquely included in the participation equation:

$$P_i^* = \lambda_P H_i^{**} + \beta_P x_i + \gamma_P z_{iP} + u_{iP},$$

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

The equation that describes the individual's true health is given as:

$$H_i^{**} = \alpha_H P_i^* + \beta_H x_{iH} + \gamma_H z_{iH} + v_{iH},$$

where H_i^{**} represents the true but unobservable health status. True health depends on the same set of individual characteristics x_i as included in the labor force participation equation, on a detailed set of personal health characteristics z_{iH} that is included only in the health equation, and on the (latent) propensity to work P_i^*. The parameter α_H thus 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 and (perceived) well-being). As said, true health H_i^{**} is unobserved. What we observe is the subjective, self-assessed health H_i, measured on a five-point scale (see section 3). Let H_i^* be the continuous latent counterpart of the observed self-assessed health, and assume $H_i = k (k = 0, ..., 4)$ when $m_k < H_i^* \leq m_{k+1}$ (m_k are unknown cut-off points to be estimated along with the other parameters while $m_0 = -\infty$ and $m_5 = \infty$).

In addition to the effect of labor on true health, measured by ?H, there is the justification hypothesis that states that non-participants justify their non-participation by exaggerating the self-assessed health problems (see section 2). If justification is a problem, there will be a difference between the true and the self-assessed health,

$$H_i^* = H_i^{**} + \delta_H P_i^* + \varepsilon_{iH},$$

with a positive value of the parameter σ_H: when participating elderly (who have a larger value of P_i^*) report a better health status (H_i^*) than they have in reality (H_i^{**}).

Substitution of the latter relation, rearranged as $H_i^{**} = H_i^* - \delta_H P_i^* - \varepsilon_{iH}$, in the participation equation yields the labor force participation equation that forms the basis of the empirical work:

$$P_i^* = \lambda_P^1 H_i^* + \beta_P^1 x_i + \gamma_P^1 z_{iP} + u_{iP}^1 \tag{1}$$

where $\lambda_P^1 = \lambda_P/(1 + \delta_H \lambda_P), \beta_P^1 = \beta_P/(1 + \delta_H \lambda_P), \gamma_P^1 = \gamma_P/(1 + \delta_H \lambda_P)$ and $u_{iP}^1 = (u_{iP} - \lambda_P \varepsilon_{iH})/(1 + \delta_H \lambda_P)$. Substitution of the relation between true and self-assessed health in the true health equation gives the empirical model for H_i^*:

$$H_i^* = \alpha_H^1 P_i^* + \beta_H x_i + \gamma_H z_{iH} + u_{iH} \tag{2}$$

where $\alpha_H^1 = \alpha_H + \delta_H$ and $u_{iH} = v_{iH} + \varepsilon_{iH}$.

Equations (1) and (2) 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_H) is not identifiable. However the sign of α_H^1 can give useful information about which type of endogeneity dominates.

4.2. *Estimation of the Model*

Equations (1) and (2) constitute a simultaneous equations model. The inclusion of different variables in z_{iH} and z_{iP} guarantees the identification of the model, but it cannot be estimated by standard techniques because we observe qualitative dependent variables instead of continuous variables. Given that the observed self-assessed health H_i is measured on a five-point scale, and assuming that u_{iH} and u_{iP}^1

are normally distributed, equation (2) is essentially an ordered probit model, while equation (1) is a probit model.

Stern (1989) proposes a two-stage approach, essentially an instrumental variable method, to estimate the parameters of the model formed by equations (1) and (2). In the first stage, a reduced form participation equation including all the variables in x_i, z_{iH} and z_{iP} is estimated via a probit procedure. The results from that estimation can be used to calculate the propensity to participate in the labor market, $P_i^{\wedge}$. In the same manner, a reduced form health equation can be estimated by ordered probit, whose results can be used to calculate the predicted 'health stock' $\hat{H}_i$ of each individual.

In the second stage the structural model defined by equations (1) and (2) is estimated, where the predictions $\hat{H}_i$ and $P_i^{\wedge}$ replace the potentially endogenous explanatory variables H_i^* and P_i^*:

$$P_i^* = \lambda_P^1 \hat{H}_i + \beta_P^1 x_i + \gamma_P^1 z_{iP} + u_{iP}^1 \tag{3}$$

$$H_i^* = \alpha_H^1 P_i^{\wedge} + \beta_H x_i + \gamma_H z_{iH} + u_{iH} \tag{4}$$

For equation (3) a standard probit with P_i as dependent variable suffices while equation (4) with H_i as the dependent variable can be estimated by ordered probit. Standard errors can be bootstrapped to account for the inclusion of the predicted variables $P_i^{\wedge}$ and $\hat{H}_i$. The two-stage approach gives consistent estimates but ignores the correlation between the error terms u_{iH} and u_{iP}^1. Nonzero correlation could be allowed in a maximum likelihood procedure, which would give estimates that are both consistent and efficient, but a simultaneous equations model of an ordered probit and probit type is not straightforward to estimate. Only Cai and Kalb (2006) follow a full-information maximum likelihood approach and find an insignificant correlation for men and a significantly negative value for women. The negative value implies that not controlling for this correlation would give a bias towards zero in the effect of health on participation (Stern, 1989; Cai and Kalb, 2006). We have more detailed information than Cai and Kalb (2006), both on work history and on diseases and symptoms, which is likely to diminish the probability that omitted unobserved factors affect both labor force participation and health, and thus increases the likelihood that our assumption that the correlation (ρ) equals zero is valid.[5]

[5] Application of an unofficial *Stata* command to estimate recursive bivariate

We are interested in knowing the causal effect of health on participation. 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 $H_0 : (\alpha_H^1 = 0, \rho = 0)$, 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). Due to the assumed absence of correlation, it remains a partial test for exogeneity. An alternative test for the exogeneity of health in the participation decision is the Hausman test (Smith and Blundell, 1986). A regression-based Hausman test adds the prediction error of the health equation (4), $\hat{u}_{iH} = H_i^* - \hat{H}_i$, as an explanatory variable to the participation equation (1) and tests its significance. If the prediction error has a significant contribution in the explanation of labor force participation, there is evidence that the model suffers from misspecification, which can be due to endogeneity of health. A complication is that the test requires an observable measure, while the latent variable H_i^* in equation (1) is not observed. We will replace it by the observable variable H_i. Kalwij and Vermeulen (2007) use an intuitively appealing approach by including both the self-assessed health H_i in the equation as well as the set of diseases and symptoms underlying the predictions $\hat{H}_i$, thereby providing an alternative to the Hausman test. In this paper the three approaches for the exogeneity and misspecification tests are applied.

4.3. *Expectations*

The consequence of endogeneity due to justification is that when self-assessed health is treated as exogenous in the participation equation, the effect of health on participation tends to be overestimated: the relation between participation and health appears stronger because the exaggeration of health problems by the non-participating elderly generates a causation running in the opposite direction. Instrumentation with objective measures corrects for this justification bias and will reduce the estimated effect of health in comparison with a model that applies self-assessed health as an explanatory variable.

Direct causality from labor force participation to (true) health can have positive and negative effects, as mentioned before. If work

ordered probit models (Sajaia, 2007) suggests that the correlation is indeed small.

makes people happier we will overestimate the relation when estimating participation as a function of health because part of the causation runs in the other direction, similar to the effect of the justification hypothesis. Instrumentation gives a corrected effect that is lower than the effect found when using self-assessed health. A negative direct causation exists if labor circumstances make people sick. Using health as an explanatory variable of the participation decision then underestimates the true effect because it will include the causal effect that runs in the opposite direction. In that case instrumentation will give a larger parameter estimate than a model with self-assessed health.

A third reason for biases is incorrect measurement. In linear models, measurement errors in explanatory variables typically result in estimated effects biased towards zero (Wooldridge, 2002:75). In limited-dependent variable models this does not always hold, but often it remains true (Hausman, 2001). Thus if measurement error in the health variable is a problem, that is if self-assessed health does not fully describe the relevant health situation, instrumentation will generally strengthen the effect of health.

5. Results

In this section the results of the estimation of the two-stage model outlined in the previous section are discussed. We briefly comment on the results of the first-stage reduced forms as it gives an idea of the validity of the constructed variables, before we move on to the structural model and finish with the alternative tests.

5.1. *First-Stage Regressions*

The first-stage results (Appendix) show a strong link between the self-assessed health status and the more detailed health indicators (z_{iH}). This is what we hoped for, as these are the exogenous identifying variables that get excluded from the second-stage labor force participation equation. Especially having diabetes or a respiratory disease (asthma), or having survived a heart attack strongly reduce the perceived health. Other diseases like rheumatism, high blood pressure, liver and kidney problems, pneumonia, or ever having suffered from cancer or a stroke have smaller but important effects on the reported health. Having fallen down or having suffered tuberculosis has a less pronounced relation to perceived health. Mental

health problems and functional limitations with the performance of the activities of daily living (adl) also have strong negative effects on the self-assessed health.

Several of the characteristics describing the career history (z_{iP}), which will be excluded from the second-stage health equation, are significant in the reduced-form labor force participation equation. In particular people who used to be self-employed or who worked as a boss in their main job during their work-life are more likely to be at work at the moment of the survey than salaried employees.[6]

The first-stage reduced-form models are used to calculate the predictions $\hat{H}_i$ and $P_i^{\wedge}$ that are used in the second-stage (structural) regressions given by equations (3) and (4).

5.2. *Second Stage Regressions*

The first column of table 4 shows that the predicted health stock has a positive and significant effect on the labor force participation. Better health is associated with a stronger attachment to the labor market. The parameter estimate of 0.310 implies that for the average elderly person in the sample, an increase in health from its mean value by one standard deviation (say, roughly a shift from 'fair' to 'good' health) raises the probability of being employed from 0.559

[6] 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 but have an independent effect on participation. Dropping the involved diseases and symptoms gives a set of variables that passes the test, but obviously invalidates the interpretation of the constructed health stock as a measure that summarizes all health conditions. Second-stage estimations, which separately include the health variables that have an independent effect on participation have been performed, and give largely the same results while complicating the interpretation compared to estimations with one health measure. Therefore we follow the literature and present the results of second-stage estimations using all objective characteristics to create one general measure for the health stock ($\hat{H}_i$) (see also table 5 and the section on alternative tests). For the construction of the labor force participation index there are no indications that the exclusion restrictions do not hold.

to 0.657. The estimated parameter of the propensity of labor force participation in the health equation (table 4, column 2) is small and insignificant (-0.011), which confirms the hypothesis that health can be considered as an exogenous variable ($H_0 : \alpha_h^1 = 0$). The result thus indicates that labor force participation does not affect the reported health status. 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).

Financial variables have the expected impact on participation. We find that elderly aged over 65 who ever made contributions to a retirement fund are less likely to be observed in employment, although the effect is only weakly significant. The negative effect, however, is reinforced by the finding that the more years one contributed the less likely is current participation. A simulation in which we implement contributions to pension funds for every elderly during maximum 40 years (from age 25 to 65), reduces the probability of participation for an average person aged over 65 from 0.325 to 0.235. This is a large change, and probably even an overestimate of the participation as the maintained assumption is that the reactions to all other factors do not change. Imposing life-long contributions essentially implies that everyone is able to claim benefits, which, although nothing is said about the size of the pension, is a major shift that may have impacts on the reactions to other factors. For the elderly under 65 we find that those who have ever participated in a retirement fund are more likely to be employed at the moment of the survey, which is in line with the requirements of the funds. A simulation that supposes that the elderly made contributions since they were aged 25 shows a small increase of the participation rate from 0.679 to 0.704. Furthermore, we find that elderly with more non-business assets (*e.g.* savings or a house) are less likely to be working, suggesting that for wealthier people it is easier to decide to retire. A general increase of non-business assets by one standard deviation however gives only a small reduction of the participation rate from 0.559 to 0.539.

A noteworthy effect is the gender effect on participation: even after the initial elimination of (in majority female) persons who never had a job, we find a significantly lower participation among elderly women. The parameter estimate of -1.046 means that a man with sample-average characteristics has a participation probability of 0.731 while for a woman with equal characteristics the probability is only 0.333.[7] Participation among couples is lower than for single-living

[7] The models have also been estimated with interaction terms. The interac-

elderly, while living in a rural area increases the participation probability. Age has a steadily negative effect on the participation probability.

The second column of table 4 shows that higher educated people on average report better health, all other factors being equal, possibly because of a higher awareness of health risks and increased access to health care services. Somewhat surprisingly, speakers of indigenous languages –often associated with lower education and poverty– report better health. Living in a rural area on the other hand reduces the reported health, given the other characteristics including the detailed description of health.

The results suggest that there is no endogeneity problem with health. It remains possible that people justify inactivity in the labor market by exaggerating their health problems, and that bad labor conditions reduce health, while the net effect is equal to zero. Another question that remains is whether the subjective and objective health measures capture all the relevant aspects of health.

5.3. *Alternative Tests*

In the first column of table 5 the self-assessed (subjective) health is used as if it were an exogenous variable. Comparison of these results with the estimates in table 4 (column 1) shows that the use of the predicted health stock leads to a stronger effect of health on labor force participation than the uncorrected estimates. Apparently, treating health as exogenous underestimates the effect of health, which is more in line with a direct negative effect of participation on health than with the justification hypothesis. The (partial) test in table 4 however indicates that there is no endogeneity problem due to reverse causality with self-assessed health, which suggests that justification and direct causality eliminate each other, and therefore another reason for the underestimation becomes more likely: the effect can also be explained by a measurement error problem in the health variable.

The second column of table 5 shows the results of a Hausman test including the difference between observed self-assessed health and predicted health stock to the labor force participation equation (eq. 1),

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tion terms of age and gender are insignificant both in the participation and in the health equation. Interaction between health and gender shows that the effect of health on participation is smaller for women than for men. Qualitatively the results do not change while it complicates the presentation (Ai and Norton, 2003). Therefore the results without interaction terms are presented and discussed. Further research could focus on (other) gender differences.

while replacing the latent (continuous) H_i^* by the observed (five-point scaled) H_i. We find a significant parameter estimate for the differential term, which provides an indication that self-assessed health is endogenous. The alternative hypothesis in the Hausman test however is very general and merely indicates that there is a problem with the specification of the model. An issue with measurement errors, for example because self-assessed health does not correctly represent true health, can also cause the significance of this parameter test.[8]

Another approach is to include all the objective health measures in the participation equation along with the self-assessed health. In the third column of table 5 we see that both the self-assessed health and several of the objective measures are significant.[9] The implication is that the subjective and objective measures do not provide the same information but instead complement each other. If they would be substitutes, either one would be significant but not both. The finding that the effect of subjective health remains significantly positive when objective measures are included is an indication that the self-assessed health captures variations that are not picked up by the objective measures, showing the incompleteness of the set of objective characteristics. However this is equally true for the subjective self-assessed health: it does not capture all health aspects that are relevant in the participation decision.

Important to note is that the impact of other characteristics, and in particular of the financial variables, is rather insensitive to the methods used to include health status. The main differences are that the effects of education and type of occupation become slightly stronger after instrumentation.

[8] The same test but using the health measures that did not qualify as instruments (see note 6) as additional potential endogenous variables, and thus also adding the difference between their true and predicted values as additional variables to equation (1), shows that in that case the set of prediction errors is not jointly significant. This suggests that incomplete measurement causes the misspecification.

[9] The first-stage regressions already suggested that this could be the case (see note 6). Similar findings are reported by Kalwij and Vermeulen (2007) for several European countries and Dwyer and Mitchell (1999) for the US.

Table 4

Second-stage structural-form regression

	labor force participation (probit, eq. 3)		*self-assessed health (ordered probit, eq. 4)*	
health (lin.pred.)	0.310***	(0.021)		
labor force part. (lin.pred.)			-0.011	(0.033)
age	-0.046**	(0.021)	-0.047***	(0.015)
age squared (*100)	-0.001	(0.016)	0.034***	(0.012)
gender: female	-1.046***	(0.038)	-0.005	(0.045)
# children (live births)	-0.002	(0.004)	-0.007 **	(0.004)
married/living together 2001	-0.227 ***	(0.034)	-0.102 ***	(0.029)
educ.: primary	-0.138***	(0.047)	0.067*	(0.038)
educ.: secondary	-0.126*	(0.075)	0.250 ***	(0.059)
educ.: technical/commercial	-0.199 **	(0.081)	0.313 ***	(0.059)
educ.: preparatory or higher	-0.051	(0.082)	0.437 ***	(0.052)
able to read and write	0.051	(0.056)	-0.018	(0.044)
able to count from 1 to 10	0.149 **	(0.068)	-0.027	(0.054)
able to speak English	-0.115**	(0.054)	0.188 ***	(0.041)
able to speak indigenous language	0.013	(0.057)	0.113 ***	(0.041)
locality size: 15000-100000	0.080 *	(0.041)	-0.164 ***	(0.033)
locality size: 2500-15000	0.185 ***	(0.055)	-0.202 ***	(0.045)
locality size: <2500	0.224 ***	(0.048)	-0.253 ***	(0.034)

Table 4

(*continued*)

	labor force participation (probit, eq. 3)		*self-assessed health (ordered probit, eq. 4)*	
non-business assets (*$1mln)	-0.079 ***	(0.024)	0.102 ***	(0.019)
hypertension/high blood pressure			-0.222 ***	(0.025)
diabetes/high blood sugar level			-0.508 ***	(0.034)
cancer/malignant tumor			-0.199 *	(0.102)
respiratory disease (e.g. asthma)			-0.395 ***	(0.050)
heart attack			-0.323 ***	(0.071)
stroke			-0.193 **	(0.088)
arthritis/rheumatism			-0.225 ***	(0.030)
liver/kidney infection (in last 2 yrs)			-0.211 ***	(0.040)
tuberculosis (in last 2 yrs)			-0.045	(0.186)
pneumonia (in last 2 yrs)			-0.178 *	(0.107)
fallen down (in last 2 yrs)			-0.071 ***	(0.026)
# mental health problems (max.9)			-0.128 ***	(0.005)
# problems with (i)adl (max.22)			-0.077 ***	(0.004)
< 65; ever deposited in pension fund	0.332 ***	(0.057)		
≤ 65; ever deposited in pension fund	-0.112 *	(0.067)		
# years with pension fund deposits	-0.006 ***	(0.002)		
occ.: agriculture	0.025	(0.050)		

Table 4

(*continued*)

	labor force participation (probit, eq. 3)		*self-assessed health (ordered probit, eq. 4)*	
occ.: proff., technic., educat.	-0.051	(0.069)		
occ.: management position	0.148	(0.120)		
occ.: administrative activ.	-0.185 ***	(0.064)		
occ.: merchants, sales repr.	0.352 ***	(0.051)		
occ.: service ind., domest. w.	-0.057	(0.044)		
occ.: other	-0.405 *	(0.209)		
contr.: boss	0.590 ***	(0.091)		
contr.: self-employed	0.533 ***	(0.038)		
contr.: commission, other paym	0.169 ***	(0.058)		
contr.: without payment	-0.038	(0.086)		
contr.: other/unknown	0.041	(0.173)		
constant	4.146 ***	(0.683)		
cut-off point 1 (m_1)			-3.935 ***	(0.513)
cut-off point 2 (m_2)			-2.227 ***	(0.514)
cut-off point 3 (m_3)			-0.735	(0.514)
cut-off point 4 (m_4)			-0.093	(0.514)
number of obs.	10183		10183	
log likelihood	-5299.2		-10427.4	

Table 4

(*continued*)

	labor force participation (probit, eq. 3)		*self-assessed health (ordered probit, eq. 4)*	
Wald χ^2 (33) *vs.* constant-only	2725.0 ***	$p = 0.000$		
Wald χ^2 (31) *vs.* constant-only			3518.0 ***	$p = 0.000$
McFadden R^2	0.245		0.172	

Note: Estimated coefficients, standard errors in parentheses. ***, **, *: significant at 1%, 5%, 10%. Standard errors are bootstrapped (1000 replications, resampling with replacement, confidence intervals based on normal approximation).

Table 5

Alternative tests of endogeneity and misspecification of health

	[1] *Subjective information*		[2] *Hausman-test*		[3] *Subj. & obj. information*	
self-assessed health (0-4)	.214 ***	(.018)	.358 ***	(.023)	.118 ***	(.020)
age	-.054 ***	(.020)	-.046 **	(.021)	-.063 ***	(.020)
age squared (*100)	.003	(.015)	-.001	(.016)	.013	(.016)
gender: female	-1.104 ***	(.037)	-1.048 ***	(.038)	-1.080 ***	(.039)
# children (live births)	-.005	(.004)	-.002	(.004)	-.003	(.004)
married/living together 2001	-.236 ***	(.034)	-.228 ***	(.034)	-.232***	(.034)
educ.: primary	-.110 **	(.047)	-.135 ***	(.047)	-.121 **	(.047)
educ.: secondary	-.056	(.073)	-.126 *	(.075)	-.084	(.073)
educ.: technical/commercial	-.103	(.080)	-.198 **	(.082)	-.133 *	(.080)
educ.: preparatory or higher	.072	(.081)	-.048	(.082)	.044	(.082)
able to read and write	.044	(.055)	.049	(.056)	.041	(.056)
able to count from 1 to 10	.137 **	(.066)	.151 **	(.068)	.137 **	(.067)
able to speak English	-.082	(.052)	-.119 **	(.054)	-.078	(.052)
able to speak indigenous language	.046	(.056)	.011	(.057)	.033	(.056)
locality size: 15000-100000	.057	(.041)	.082 **	(.042)	.026	(.042)
locality size: 2500-15000	.166 ***	(.054)	.186 ***	(.054)	.142 ***	(.055)
locality size: < 2500	.189 ***	(.048)	.225 ***	(.048)	.164 ***	(.049)
non-business assets (*$1mln)	-.060**	(.023)	-.081***	(.024)	-.056**	(.024)

Table 5

(*continued*)

	[1] *Subjective information*		[2] *Hausman-test*		[3] *Subj. & obj. information*	
<65; ever deposited in pension fund	.336 ***	(.057)	.331 ***	(.057)	.345 ***	(.057)
≥ 65; ever deposited in pension fund	-.102	(.069)	-.114 *	(.067)	-.106	(.069)
# years with pension fund deposits	-.006***	(.002)	-.006***	(.002)	-.006***	(.002)
occ.: agriculture	.017	(.049)	.025	(.050)	.013	(.050)
occ.: proff., technic., educat.	-.031	(.068)	-.054	(.069)	-.026	(.069)
occ.: management position	.179	(.118)	.148	(.120)	.185	(.118)
occ.: administrative activ.	-.155 **	(.066)	-.187 ***	(.064)	-.161 **	(.066)
occ.: merchants, sales repr.	.361 ***	(.051)	.351 ***	(.051)	.351 ***	(.052)
occ.: service ind.,domest.w.	-.053	(.044)	-.057	(.044)	-.062	(.044)
occ.: other	-.376 *	(.203)	-.404*	(.210)	-.414**	(.205)
contr.: boss	.606 ***	(.086)	.594 ***	(.092)	.630 ***	(.088)
contr.: self-employed	.533 ***	(.038)	.534 ***	(.038)	.524 ***	(.038)
contr.: commission, other paym	.163 ***	(.056)	.168 ***	(.057)	.160 ***	(.057)
contr.: without payment	-.000	(.083)	-.037	(.086)	-.005	(.084)
contr.: other/unknown	.065	(.171)	.043	(.173)	.065	(.173)
health prediction error			-.243 ***	(.024)		
hypertension/high blood pressure					-.063 **	(.031)
diabetes/high blood sugar level					-.148 ***	(.040)

Table 5

(*continued*)

	[1] *Subjective information*		[2] *Hausman-test*		[3] *Subj. & obj. information*	
cancer/malignant tumor					.020	(.105)
respiratory disease (e.g. asthma)					.066	(.061)
heart attack					-.075	(.082)
stroke					-.296***	(.098)
arthritis/rheumatism					.059	(.037)
liver/kidney infection (in last 2 yrs)					.041	(.048)
tuberculosis (in last 2 yrs)					-.181	(.300)
pneumonia (in last 2 yrs)					.099	(.128)
fallen down (in last 2 yrs)					.078 **	(.031)
# mental health problems (max. 9)					.001	(.006)
# problems with (i)adl (max. 22)					-.052***	(.004)
constant	3.425 ***	(.641)	3.823 ***	(.687)	3.895 ***	(.664)
number of obs.	10183		10183		10183	
log likelihood	-5334.9		-5282.5		-5226.9	
Wald χ^2 (33) *vs.* constant-only	2433.0***	$p = .000$				
Wald χ^2 (34) *vs.* constant-only			2708.8***	$p = .000$		

Table 5

(*continued*)

	[1] *Subjective information*		[2] *Hausman-test*		[3] *Subj. & obj. information*	
Wald χ^2 (46) *vs.* constant-only					2489.4***	$p = .000$
Wald χ^2 (13) of obj. health char.					206.5***	$p = .000$
McFadden R^2	.240		.247		.255	

Estimated coefficients, standard errors in parentheses. ***, **, *: significant at 1%, 5%, 10%. Dependent variable in each column is labor force participation. Columns 1 and 3 contain heteroskedasticity-corrected standard errors, while standard errors for column 2 are bootstrapped (1000 replications, resampling with replacement, confidence intervals based on normal approximation).

6. Conclusions

We investigated the labor participation decision for elderly in Mexico, and in particular we studied the role of health in this decision. A relevant consideration in this type of analysis is the measurement of health and its potential endogeneity. Self-assessed health is suspected to depend on the actual labor force decision that is observed; people may justify inactivity by exaggerating their health problems. Health can also directly depend on participation, for example due to bad labor conditions. The data used in this paper, drawn from the 2001-wave of the Mexican Health and Aging Survey, include self-assessed health status and also contain detailed information on the prevalence of various diseases and symptoms. This allows us to test the validity of the use of self-assessed health in models explaining the labor force participation decision.

The various estimations do not indicate that the self-assessed health status is an endogenous variable when explaining the labor force participation of elderly workers. We find a strong effect running from health to participation, where better health increases the probability of participation in the labor market, while we find no clear evidence of a causation running in the other direction. However it remains possible that a negative direct effect of work on health exists but is offset by the (opposing) justification effect. Our findings are not uncommon in the literature: evidence of causation from participation to health is generally weak while the effect of health on the participation decision is often found to be strong. However a direct comparison of the strength of the relations with the literature is complicated because of the wide variety of methods used to measure health.

We find indications that there is a measurement issue. The results suggest that the self-assessed health does not capture all relevant health aspects, but that some diseases and symptoms have independent effects on labor force participation. Despite their effects on the self-assessed health, the impact on labor force participation is not sufficiently captured in the self-assessed health: productive capacity is reduced more. Simply replacing self-assessed health by the objective health characteristics, or a construct thereof, appears too rough to catch the effect of health. However, the other variables explaining the participation decision are rather insensitive to the inclusion of self-assessed health, health stock, or a set of objective characteristics. This suggests that as long as the interest of the researcher is not the health per se, self-assessed health can be used in the analysis.

An important result is that the role of financial considerations in Mexico is not different from other countries: those who contributed to a retirement fund are more likely to withdraw from the labor market when they satisfy the requirements to receive a pension. However the number of employees who made such contributions is much lower than in other countries, which explains why more elderly remain active in the labor market. Although it is a bit premature to draw far-reaching conclusions, it seems clear that general improvements in opportunities for financial support after retirement will increase the number of non-working elderly. Together with an aging population that would imply that a relatively decreasing number of young employees will have to pay the benefits for an increasing number of retirees. The finding that health is a relevant determinant in labor decisions implies that policies aimed at improving the general health situation are likely to contribute to the future labor force participation. However, general improvement of health is by definition a slow process that can therefore only partially compensate the pressure on the pension system that will be created if more elderly enjoy retirement benefits.

Future research should exploit the panel structure of the data to analyze the relation between changes in health and changes in labor market status. In general, more detailed analysis of the health gradient seems important, as we find that the constructs used in this paper do not unequivocally capture all relevant aspects. Another potential improvement is to distinguish subgroups and allow different effects for men and women, and for different age groups. In this paper all persons aged over 50 are included in one analysis. We find strong indications that labor force participation is much more likely for men than for women, and the (implicit) assumption that the effects of other explanatory variables are equal for men and women may be too strong. The same may hold for different age groups. Future analysis should study the difference between retirement as defined in this paper (not active in the labor market) and the actual receipt of retirement benefits, in combination with the fact that the latter does not imply that the recipient is not working in another (formal or informal) job. A related aspect that deserves attention is the potential impact of access to medical services, which generally is linked to formal employment.

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Appendix

First-stage reduced-form estimations

	labor force participation (probit)		*self-assessed health (ordered probit)*	
age	-0.066 ***	(0.020)	-0.047 ***	(0.015)
age squared (*100)	0.016	(0.016)	0.034 ***	(0.011)
gender: female	-1.077 ***	(0.039)	-0.001	(0.029)
# children (live births)	-0.004	(0.004)	-0.007*	(0.004)
married/living together 2001	-0.238 ***	(0.034)	-0.100***	(0.027)
educ.: primary	-0.119 **	(0.047)	0.059	(0.038)
educ.: secondary	-0.070	(0.073)	0.206 ***	(0.058)
educ.: technical/commercial	-0.118	(0.080)	0.243 ***	(0.064)
educ.: preparatory or higher	0.064	(0.081)	0.342 ***	(0.063)
able to read and write	0.043	(0.055)	-0.025	(0.045)
able to count from 1 to 10	0.132 **	(0.067)	-0.027	(0.054)
able to speak English	-0.061	(0.052)	0.182 ***	(0.041)
able to speak indigenous language	0.044	(0.056)	0.122 ***	(0.042)
locality size: 15000-100000	0.014	(0.042)	-0.154 ***	(0.034)
locality size: 2500-15000	0.127 **	(0.055)	-0.177 ***	(0.044)
locality size: <2500	0.148 ***	(0.049)	-0.214 ***	(0.038)

Appendix

(*continued*)

	labor force participation (probit)		*self-assessed health (ordered probit)*	
non-business assets (*$1mln)	-0.046*	(0.024)	0.093 ***	(0.018)
hypertension/high blood pressure	-0.079**	(0.031)	-0.223 ***	(0.025)
diabetes/high blood sugar level	-0.184***	(0.040)	-0.511 ***	(0.034)
cancer/malignant tumor	0.008	(0.105)	-0.198 *	(0.103)
respiratory disease (e.g. asthma)	0.040	(0.061)	-0.398 ***	(0.051)
heart attack	-0.097	(0.082)	-0.337 ***	(0.070)
stroke	-0.307 ***	(0.098)	-0.188 **	(0.084)
arthritis/rheumatism	0.043	(0.037)	-0.223 ***	(0.030)
liver/kidney infection (in last 2 yrs)	0.025	(0.048)	-0.213 ***	(0.040)
tuberculosis (in last 2 yrs)	-0.172	(0.298)	-0.036	(0.178)
pneumonia (in last 2 yrs)	0.086	(0.127)	-0.170	(0.100)
fallen down (in last 2 yrs)	0.073 **	(0.031)	-0.071 ***	(0.025)
# mental health problems (max. 9)	-0.008	(0.006)	-0.128 ***	(0.005)
# problems with (i)adl (max. 22)	-0.057 ***	(0.004)	-0.077 ***	(0.004)
< 65; ever deposited in pension fund	0.350 ***	(0.057)	0.051	(0.043)
≥ 65; ever deposited in pension fund	-0.098	(0.069)	0.061	(0.056)
# years with pension fund deposits	-0.006 ***	(0.002)	0.000	(0.002)
occ.: agriculture	0.010	(0.050)	-0.058	(0.040)

Appendix

(*continued*)

	labor force participation (probit)		*self-assessed health (ordered probit)*	
occ.: proff., technic., educat.	-0.017	(0.068)	0.102 *	(0.053)
occ.: management position	0.196 *	(0.118)	0.148 *	(0.087)
occ.: administrative activ.	-0.152 **	(0.066)	0.098 *	(0.050)
occ.: merchants, sales repr.	0.354 ***	(0.051)	0.022	(0.040)
occ.: service ind., domest. w.	-0.060	(0.044)	0.014	(0.036)
occ.: other	-0.415 **	(0.204)	-0.006	(0.152)
contr.: boss	0.636 ***	(0.087)	0.148 **	(0.063)
contr.: self-employed	0.523 ***	(0.038)	-0.008	(0.030)
contr.: commission, other paym	0.163 ***	(0.057)	0.015	(0.046)
contr.: without payment	0.002	(0.084)	0.109 *	(0.066)
contr.: other/unknown	0.070	(0.173)	0.101	(0.138)
constant	4.218 ***	(0.661)		
cut-off point 1 (m_1)			-3.895 ***	(0.481)
cut-off point 2 (m_2)			-2.185 ***	(0.480)
cut-off point 3 (m_3)			-0.691	(0.480)
cut-off point 4 (m_4)			-0.048	(0.480)
number of obs.	10183		10183	
log likelihood	-5244.2		-10415.7	

Appendix

(*continued*)

	labor force participation (probit)		*self-assessed health (ordered probit)*	
Wald χ^2 (45) *vs.* constant-only	2481.6 ***	$p = 0.000$	3398.3 ***	$p = 0.000$
Wald χ^2 (13) of obj. health char.			2345.0 ***	$p = 0.000$
Wald χ^2 (15) of labor history	496.4 ***	$p = 0.000$		
McFadden R^2	0.252		0.173	

Note: Estimated coefficients, heteroskedasticity-corrected standard errors in parentheses. ***, **, *: significant at 1%, 5%, 10%.