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Health and Labor Supply of the Elderly in Rural China

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Abstract

Deborah Davis-Friedmann (1991) described the "retirement" pattern of the Chinese elderly in the pre-reform era as "ceaseless toil": lacking sufficient means of support, the elderly had to work their entire lives. In this paper we re-cast the metaphor of ceaseless toil in a labor supply model, where we highlight the role of age and deteriorating health. The empirical focus of our paper is (1) Documenting the labor supply patterns of elderly Chinese; and (2) Estimating the extent to which failing health drives retirement. We exploit the panel dimension of the 1991-93-97 waves of the China Health and Nutrition Survey, confronting a number of econometric issues, especially the possible contamination of age by cohort effects, and the measurement error of health. In the end, it appears that "ceaseless toil" is also an accurate depiction of elderly Chinese work patterns since economic reform, but failing health only plays a small observable role in explaining declining labor supply over the life-cycle.

Keywords: retirement, health and labor supply, social security, China
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1.0 Introduction

Industrialization, with the shift of workers from farm to factory, is a primary impetus for the implementation of public old age security programs. For example, these programs were legislated in the United States in the 1930s, as policy makers recognized that elderly factory workers could not rely on farm wealth or extended families to take care of them after they retired, as they had in the previous century.[1] A similar process is underway in many developing countries, also spurred by an urban-rural contrast in the perceived need for social security: The elderly in the countryside can take care of themselves, either through productive farm work or extended family arrangements, while the urban elderly cannot. China is a typical example, where recent proposals for pension reform highlight the need for a national social security program covering vulnerable urban workers.[2] But the narrow focus on urban elderly, which assumes that the rural elderly are well taken care of, has no empirical basis, especially in China.[3]

For starters, per capita incomes are generally lower in rural areas (including for the elderly). Moreover, there is no reason to believe that informal social security arrangements are sufficient in the Chinese countryside. While not as severe as in the cities, fertility restrictions since the late 1970's in rural areas reduced family sizes, increasing the potential burden of elder-support for each child. Rapid out-migration means even fewer children remain in the villages to take care of their parents. Nor is there is evidence, especially with recent adverse employment shocks in the cities related to SOE restructuring,

[1] See the extensive discussion of the evolution of US (and other developed country) old age security at the Social Security Administration website, http://www.ssa.gov/history/.

[2] The early proposals for pension reform in China (as in World Bank (1994) and World Bank (1997)) if anything, *underestimated* the need for pension reform for urban workers: Restructuring of State Owned Enterprises (SOE's) has led to massive layoffs, especially in the form of "early retirement." Compounding difficulties for the retirees, SOE insolvency often implies effective default on their pensions and health insurance coverage. A reduction in family size as a result of strictly enforced fertility restrictions mean there are fewer children to offer support. Moreover, the children are as likely to be unemployed themselves.

[3] Benjamin, Brandt, and Rozelle (2000) provide evidence of the relative incomes of elderly in rural and urban China, as well as a more general discussion of historical and contemporary "aging" issues in China.

that migrant children's remittances off-set the decline in traditional living arrangements-based social security.

The legacy of collectivization – including the current land tenure system – makes matters worse. In contrast to the United States historically, or other developing countries at present, the elderly in China did not grow old in an environment where they could accumulate assets – notably land – either to directly support themselves, or to "encourage" (facilitate) inter-generational transfers from their children (heirs). Constraints on saving mean that current cohorts of elderly are especially ill-prepared to adjust to the changing economic structure, with the erosion of the family as a means of support. Not surprisingly, retirement maybe a luxury few in the countryside can afford.

Even under collectivization, however, the relative position of the elderly declined sharply from the pre-1949 period. The primary means of economic support was through "work points" (wages) earned by working on collectively-owned land. Today, under the Household Responsibility System, land remains "collectively-owned," and the primary means of income support for anyone (including the elderly) in the countryside is through the allocation of use-rights to land. By its very nature, this form of transfer entails a "work requirement" unless, of course, the elderly can get their children to cultivate the land. An especially critical observer can thus draw parallels between this form of community support for the elderly, and nineteenth-century almshouses, which also catered to the elderly poor. It was the destitution of the elderly and their need to work in poor-houses that motivated social reformers in the nineteenth century to push for some form of public old age security. In Deborah Davis-Friedmann's (1991) landmark study of China's elderly under collectivization, she characterized their lifetime of work as "ceaseless toil."

The purpose of our paper is to take Davis-Friedmann's characterization as a starting point, and evaluate whether "ceaseless toil" can be given empirical content in the current reform period. Our focus is on quantifying the degree and nature of labor force attachment over the life cycle for men and women. As the image of ceaseless toil suggests, we wish to investigate whether there is evidence that Chinese elderly work until they are no longer physically capable. This entails estimating the role of health in the "retirement" decision. As Davis-Friedmann noted, however, the role of health is not independent of economic conditions. It is the underlying lack of resources (wealth or other forms of social security) that necessitates the ceaseless toil. Therefore, we also explore how economic variables – to the limit that we can observe them – interact with health and age in determining labor supply.

As there are parallels between the contemporary Chinese experience and the historical development of retirement in industrialized economies like the United States, our research draws on the work of Dora Costa (1998). She explores the relative roles that health and income (private pensions and social security) played in the evolution of retirement in the United States over the twentieth century. There is also a large related literature on the role of health in labor supply generally, and retirement specifically, in a developed country context.[4] One of the advantages of using Chinese data to estimate linkages between health and labor supply is that poor health may be a more important limiting factor for physically demanding labor, like farm work. Also, Chinese farmers withdraw from work more gradually, and without the complications of social security program parameters, which may afford a better opportunity to observe continuous adjustments of labor supply with respect to health.

There are very few other studies that look at aging or retirement issues in developing countries, especially in a rural context. Deaton and Paxson (1992) focus on welfare issues pertaining to the elderly, Cameron and Cobb-Clark (2002) investigate labor supply of the elderly in Indonesia, while Mete and Shultz (2002) study urban retirement behavior in Taiwan. Yet, these issues are very important, especially from a policy perspective. As emphasized in the World Bank (1994) report, "demographic transition" is rapidly increasing the ratio of old to young in developing countries, but few have well-designed old-age security systems in place to meet the possible crunch. At least at the beginning, the elderly will have to fend for themselves, while the near-elderly must prepare for their old age by other means. Understanding the retirement decisions of Chinese elderly thus contributes to the general question of how the elderly support themselves in the absence of government-run social security.

[4] See Currie and Madrian (1999), Lumsdaine and Mitchell (1999), and Hurd (1990) for useful summaries of this related literature.

Our paper has the following structure. First we formalize the notion of "ceaseless toil," casting the work patterns of older Chinese couples in the context of a family labor supply model, and highlighting the ways that health and age may "cause" retirement. In this section we also describe our empirical framework and guiding question: How much does failing health "explain" observed retirement behavior? In order to do this, we estimate reduced-form labor supply and health age-profiles, and then evaluate the extent to which reductions in health line up with reductions in hours worked. An important ingredient in this decomposition is an estimate of a "structural parameter" linking health to labor supply. Second, we describe the China Health and Nutrition Survey (CHNS) panel sample that we use, and outline a host of measurement and econometric issues to consider. Third, we present the empirical results, beginning with non-parametric explorations of the age profiles. Here, the importance (and potential difficulty) of disentangling age from cohort effects is emphasized. We then report the main results of the paper, including "structural" estimates of the impact of health on labor supply. This requires an instrumental variables procedure designed to address measurement shortcomings of self-reported health. In the final section, we extend the framework in order to investigate the covariation of the aging and health effects with other economic variables, most notably, household wealth.

In the end, it appears that "ceaseless toil" is an accurate depiction of elderly Chinese work patterns, but deteriorating health plays only a small observable role in explaining labor supply over the life-cycle. Despite generally rising incomes in the countryside, we find that the elderly have not benefited, at least in terms of their ability to retire, as happened for example, historically in the United States. In fact, the deteriorating relative position of the elderly, especially combined with recent falling crop prices, further underlines the insufficiency of the current land- (and work-) based social security system to provide minimally acceptable living standards for the elderly.

2.0 Modeling ceaseless toil

"Ceaseless toil" is a metaphor for the tendency of Chinese elderly to work throughout old age, until they are no longer physically capable. The "decision" to choose this pattern of work (like any retirement decision) can be incorporated readily into a labor supply model. As we will see, the metaphor provides no testable implications. However, the labor supply model highlights the economic and other variables that determine the extent of "ceaseless toil." In particular, we focus on the channels by which age and health affect labor supply.

2.1 Ceaseless toil and labor supply

A farmer and his wife decide how much to work. For simplicity, we assume that the separation property holds, so that production and consumption decisions are independent. This means that we treat farm profits as exogenous to the labor supply decision, and assume that the farmer's labor productivity can be summarized by market wages.[5] The couple's objective is to maximize household utility:

$$\max_{\ell^M,\ell^F,c} u\left(\ell^M,\ell^F,c;\alpha(h^M,h^F,A^M,A^F,Z)\right) \tag{1}$$

where ℓ^M,ℓ^F are the husband and wife's non-market time (leisure); c is household goods' consumption; and $\alpha(h^M,h^F,A^M,A^F,Z)$ parameterizes preferences that depend in general on the husband's and wife's health (h^M,h^F), their age (A^M,A^F), and other variables, Z.

The family budget constraint is related to health and age in several possible ways:

- Productivity, as reflected in wages, $w^M\left(h^M,A^M,X^M\right),w^F\left(h^F,A^F,X^F\right)$;
- Available time, $T^M(h^M),T^F(h^F)$;
- And "non-labor income," $y\left(A^M,A^F,G\right)$, which includes farm profits, the flow of asset income, and possibly remittances from children;

where X^M,X^F and G are other (exogenous) variables that affect men's and women's productivity, and non-labor income. The budget constraint is therefore:

[5] The separation property unlikely holds in the Chinese context. To begin with, there is no real land rental market. The absence of this market (combined with imperfect labor markets) may artificially tie elderly to their farms, "forcing" them to cultivate when they otherwise would prefer not to. However, the elderly can have their children do the cultivation (implicitly using the land or labor market) and increasingly, markets exist to contract farm labor services to non-family members (i.e., concerns over imperfect farm factor markets are becoming less important).

$$w^M\left(h^M, X^M\right)\ell^M + w^F\left(h^F, X^F\right)\ell^F + pc = y\left(A^M, A^F, G\right) + w^M\left(h^M, X^M\right)T^M(h^M) + w^F\left(h^F, X^F\right)T^F(h^F) \quad (2)$$

and the resulting labor supply functions can be written:

$$L^M = f\begin{bmatrix} w^M\left(h^M, A^M, X^M\right), w^F\left(h^F, A^F, X^F\right), \\ y\left(A^M, A^M, G\right), \alpha\left(h^M, h^F, A^M, A^F, Z\right), T^M\left(h^M\right), T^F(h^F) \end{bmatrix} \quad (3)$$

We now catalogue the channels by which health affects labor supply. Consider a decrease in a farmer's health, possibly related to aging. This can affect labor supply for a number of reasons:

- *Reduction in time endowment*: An adverse health shock may reduce the farmer's available time for work. For example, he might be physically capable of working only four, instead of ten hours per day. In this case, labor supply will be reduced (as in a constrained labor supply model), with a corresponding negative income effect. This adverse income effect will affect optimal consumption of other goods, including his wife's leisure. If her leisure is a normal good, she will work more.
- *Effect on preferences*: Poor health might increase the "marginal disutility of work," (i.e., change the marginal rate of substitution between the husband's leisure and other "goods"). This will reduce the farmer's labor supply through essentially a substitution effect. Depending on whether his wife's leisure is a substitute or complement for his leisure, her labor supply will increase or decrease. For example, if the wife needs to care for her sick husband, we can view the husband's and wife's non-market time as complementary, and thus her labor supply will decrease with her husband's illness.
- *Effect on own-productivity*: A decrease in productivity – as reflected in a reduction in the farmer's wage – will have conventional income and substitution effects, with an ambiguous effect on his labor supply. Similarly, the cross-effect on the wife's labor supply is ambiguous, unless the husband and wife's non-market time (leisure) are substitutes, in which case the wife's labor supply will increase.
- *Health Costs:* The model we sketched excludes the purchase of health care services. However, if the family has to pay for the husband's medical expenses, then we can view this as another adverse income effect, which could (in principle) increase the labor supply of both the husband and wife.

- *Non-labor income:* An adverse health shock may affect non-labor income. For example, a sick farmer may not be able to manage his farm as well, and profits will fall. Or, remittances from relatives may increase in response to illness. In both cases, the health shock will add another income effect.

The main lesson to draw from this theoretical discussion is that adverse health shocks have an ambiguous impact on the labor supply of the husband and wife. Moreover, there is no obvious way to separate the various possible avenues that health affects labor supply (e.g., separating the effect of health on preferences, productivity, or the time endowment) unless we observe the individual components (like productivity). Nevertheless, the language of income and substitution effects, especially as a consequence of health's effect on productivity (wages), is a useful way to think about ceaseless toil.

Almost all of the above discussion carries over to a discussion of the effect of age on labor supply. For example, we might imagine that labor supply declines in old age because of a systematic decline in productivity: Chinese farmers work on their own farms until their productivity falls below some threshold. But why would Chinese farmers be less likely to retire than the Chinese living in cities, or men in North America? If farm productivity was the main part of the story, then we have to argue that farm productivity fell more slowly for farmers than university professors or other white collar workers. Alternatively, farm work may be more pleasant than other types of work, so that reservation wages for farm participation are very low. Neither explanation is plausible. More likely, the key variable is "income," or wealth: Chinese farmers have low wealth levels, and thus cannot "afford" to retire. In the context of our model, non-labor income has a different level or trajectory for Chinese farmers than other workers. If they are poor all of their lives, then having a lower level of permanent income means they will have to work more over their entire life-cycle. Or, limited savings mechanisms may prevent farmers from providing for their old-age. Especially if transfers from children are the main returns from "savings", it may take awhile (with imperfect credit markets and low wages for adult children) before elderly workers can "collect" their social security and retire.

Clearly, wealth and productivity may combine to explain the ceaseless nature of work in China as compared to North America. The income effect of permanently lower wages (productivity) may lead to higher lifetime labor supply, while the age-pattern of labor supply tracks the life-cycle trajectory of productivity, including the deterioration in physical strength associated with old age.

2.2 A simple labor supply function

Using (3) as a starting point, a linear version of the husband's labor supply function is given by:

$$\begin{aligned} L_{it}^{M} &= \gamma_0 + \eta_M w_{it}^{M} + \eta_F w_{it}^{F} + \eta_y y_{it} \\ &\quad + \gamma_{1M} A_{it}^{M} + \gamma_{1F} A_{it}^{F} + \gamma_{2M} h_{it}^{M} + \gamma_{2F} h_{it}^{F} + \gamma_4 Z_{it} + \theta_{it} \end{aligned} \tag{4}$$

where *i* indexes an individual, and *t* indexes time. If all variables are observable and perfectly measured, we can estimate (4), and determine the "pure" effect of age and health, controlling for the economic variables. We can also estimate the effect of age and health on the economic variables (wages and non-labor income), in order to distinguish between the various channels discussed previously. For example, the partial own-productivity effect of health on labor supply is:

$$\eta_M \frac{dw_{it}^{M}}{dh_{it}^{M}} \tag{5}$$

In this way, we can decompose the total effect of health and aging on the labor supply decision, and completely categorize the dimensions of "ceaseless toil."

Unfortunately, in a rural developing country, measurement of the economic variables is problematic. Wages are unobserved in self-employment, and estimation of "pure" farm profits is difficult. Wages may not be observed in a developed country either, so one could adopt the strategy of Abowd and Card (1989) and treat them as latent variables that shift earnings and hours according to a structural model implicit in (5). For example, with enough structure one can specify a model linking health (and age) to earnings and hours, and thus back-out the implicit impact of age on both productivity and hours. This is the strategy adopted by Laszlo (2002) in estimating the channels by which household education affects household earnings through a labor supply model. Unfortunately, we cannot pursue this strategy because we want to estimate the impact of *individual* health on individual labor supply, but we only observe *household* income. It is virtually impossible to identify the individual productivity effects in this case.

Instead, our objective is to estimate a "reduced form" version of (4). With this exercise, we can estimate the total effect of age and health on labor supply, but will be unable to decompose the sub-components of these effects. Substituting-out the economic variables yields a reduced form:

$$\begin{aligned} L_{it}^{M} &= \beta_0 + \beta_{1M} A_{it}^{M} + \beta_{1F} A_{it}^{F} + \beta_{2M} h_{it}^{M} + \beta_{2F} h_{it}^{F} + \\ &+ \beta_{3M} X_{it}^{M} + \beta_{3F} X_{it}^{M} + \beta_4 Z_{it} + \beta_5 G_{it} + \varepsilon_{it} \end{aligned} \quad (6)$$

We estimate variations of this equation, with the objective of estimating β_2 in order to evaluate the extent to which health and labor supply are linked over the life-cycle.

2.3 What if labor supply decisions are made in a dynamic framework?

For simplicity, ignore the family dimension to labor supply, and consider the consequences of the individual making his labor supply decision according to:

$$\max_{L_{it}, c_{it}} \sum_{t=0}^{T} (1+\rho)^{-t} u_t \left(c_{it}, L_{it}; A_{it}, h_{it}, \varepsilon_{it} \right) \quad (7)$$

subject to:

$$K_{i0} + \sum_{t=0}^{T} (1+r)^{-t} \left(w_{it} \left(A_{it}, h_{it} \right) L_{it} - p_t c_{it} \right) = 0 \quad (8)$$

where K_{io} is initial wealth. With appropriate functional form assumptions, we can specify a labor supply function like[6]:

$$L_{it} = \pi_0 + \pi_1 A_{it} + \pi_2 h_{it} + \pi_3 w_{it} + \pi_4 \lambda_{it} + \sigma_{it} \quad (9)$$

where λ_{it} is the marginal utility of relaxing the life-time budget constraint (8).

The main innovation in moving from the static to dynamic model is that (i) we no longer take non-labor asset income as exogenous; and (ii) we recognize that an individual's expected deterioration of productivity due to health and age is summarized in λ_{it} . In this way, we can compare readily the life-cycle trajectories of Chinese farmers and U.S. college professors, in terms of their life-time wealth

[6] See Card (1994) for more discussion of intertemporal labor supply models, and in particular, the statistical and modeling issues associated with (7) and (8). He also outlines the possible ways in which the life-cycle model can be used to account for the effect of "age" on labor supply over the life-cycle.

(reflected in λ_{it}), and their wage-age productivity profiles. We can also employ the language of intertemporal labor supply, where the age- and health-productivity relationship drives wages. Chinese farmers have lower lifetime wealth, and so work more over their entire life-cycle if leisure is a normal good. Furthermore, individuals will time their labor supply to exploit periods of relatively high productivity, with farmers taking account of their expected deterioration of productivity associated with old age. Note, it may still be difficult to explain the different retirement patterns of farmers and professors within this framework, unless we believe college professors' productivity drops sharply at age sixty-five.

Given the unobservability of wages, we can imagine estimating a reduced form equation like:

$$L_{it} = \pi_0' + \pi_1' A_{it} + \pi_2' h_{it} + \pi_4' \lambda_{it} + \sigma_{it}' \qquad (10)$$

There are subtle differences in interpretation of the impact of health on labor supply in this context. Most importantly, the health coefficient, π_2, captures a pure substitution effect, since the income effect due to anticipated health and productivity decline is controlled for by λ_{it}. Similarly, if there is a transitory health shock that does not change long run health prospects, then π_2 can be interpreted as a substitution effect. Even in this framework, however, the effect of an unexpected large adverse change in health as measured by π_2 will convolute income and substitution effects. Furthermore, there will be a possible statistical complication caused by the correlation of λ_{it} and h_{it}, especially as λ_{it} is itself unobserved. If those with higher wealth (and lower λ_{it}) also have better health, the failure to control directly for λ_{it} will generate omitted variables bias. In this case, the negative correlation between λ_{it} and h_{it} will impart a negative bias – that is, if π_2 is truly positive, the estimated health effect will be biased towards zero, or the wrong sign. In the dynamic labor supply literature, this is the primary motivation for estimating the model with fixed effects (FE) or by first differences. This is one reason (among others) that there is a potential gain to using panel data in the estimation of (6). Note, however, that the FE estimator will not help in this case if the changes in health status are permanent and unanticipated, or lead to changes in λ_{it}.

3.0 Empirical implementation

Our first objective is to estimate the "pure" effects of age on labor supply and health, which can be accomplished by estimating the reduced forms:

$$\begin{aligned} L_{it}^{M} &= \beta_0 + \beta_1 A_{it}^{M} + v_{it} \\ h_{it}^{M} &= \delta_0 + \delta_1 A_{it}^{M} + u_{it} \end{aligned} \tag{11}$$

If health declines linearly with age according to (11), and age affects labor supply entirely through health, then we can add health to the labor supply equation in (11):

$$L_{it}^{M} = \beta_0 + \beta_1 A_{it}^{M} + \beta_2 h_{it}^{M} + \varepsilon_{it} \tag{12}$$

And if health is measured perfectly, it will absorb the entire effect of age on labor supply, yielding an estimate of $\beta_1 = 0$. But health is definitely not measured perfectly, and age may affect labor supply for other reasons. To summarize the impact of health on retirement, we estimate (i) the extent to which health declines with age, δ_1, and (ii) the impact of health on labor supply, β_2. Within this model, the effect of growing older by one year affects labor supply through health by:

$$\delta_1 \beta_2 \tag{13}$$

More precisely, we estimate the reduced-form effect of age on both labor supply and health:

$$\begin{aligned} L_{it}^{M} &= \beta_0 + \sum_{j=1}^{J} \beta_{1j} AGEG(j)_{it}^{M} + v_{it} \\ h_{it}^{M} &= \delta_0 + \sum_{j=1}^{J} \delta_{1j} AGEG(j)_{it}^{M} + u_{it} \end{aligned} \tag{14}$$

where $AGEG(j)$ is an age-group indicator for five-year age groups (20-24, 25-29,… 75-79, 80 plus). We focus on two age transitions: (i) The implied change in labor supply or health between ages fifty and sixty, given by $\Delta_{6050}^{L} = \beta_{1(60-65)} - \beta_{1(50-55)}$ and $\Delta_{6050}^{h} = \delta_{1(60-65)} - \delta_{1(50-55)}$; and (ii) The implied change in labor supply and health between ages sixty and seventy ($\Delta_{7060}^{L} = \beta_{1(70-75)} - \beta_{1(60-65)}$ and $\Delta_{7060}^{h} = \delta_{1(70-75)} - \delta_{1(60-65)}$). We then estimate the "structural" effect of health on labor supply on the basis of:

$$L_{it}^{M} = \beta_0 + \sum_{j=1}^{J} \beta_{1j} AGEG(j)_{it}^{M} + \beta_2 h_{it}^{M} + \varepsilon_{it} \tag{15}$$

and define the part of retirement attributed to declining health (with age) as:

$$\beta_2 \times \Delta_{6050}^{h}, \quad \beta_2 \times \Delta_{7060}^{h} \tag{16}$$

3.1 Data

We use the China Health and Nutrition Survey (CHNS) for 1991, 1993, and 1997.[7] We exploit the panel dimension of the CHNS, restricting our analysis to those individuals that we can follow across the three surveys, including some individuals who died between waves of the survey. We further restrict our sample to men and women 20 years of age and older for whom we have a complete set of health and labor supply variables. Since we examine the impact of spousal health on labor supply, we also include only those individuals with complete spousal information. This means that we exclude single people, in particular women who outlive their husbands (i.e., widows). We now discuss a variety of econometric and measurement issues that need to be considered before we present estimates of (14) and (15). Along the way, we refer to Table 1, which presents selected summary statistics. As Table 1 shows, there are approximately 1200 men and 1200 women that satisfy the sample selection criteria, including 375 men and 296 women who are fifty years or older in 1991.[8]

3.2 Measuring labor supply

At what point can we say a farmer is "retired"? In the retirement literature, retirement is often defined to occur when a person first receives a public or private pension, irrespective of work status. This definition is clearly inappropriate for us. Another possibility is to define retirement as a complete cessation of work. Given the possibility of gradual retirement, especially for farmers, we prefer instead to look more broadly at labor supply, including hours of work and participation. Table 1 reports average levels of labor market activity. We define "work" as being engaged in an income-generating activity.

[7] The data and complete documentation are available at the website: http://www.cpc.unc.edu/china/home.html. Details of the structure of the data set are provided in the data appendix.

[8] The smaller number of older women reflects the higher mortality of husbands (prior to 1991), and the exclusion of a slightly disproportionate number of older women on the grounds of missing spousal information.

Notably, this excludes “housework,” and working in a garden for the production of home-consumed vegetables. It does include wage employment, commercial gardening, farming (for sale or home consumption), raising animals, fishing, and working in a family enterprise. Participation rates in work are 92 and 93 percent for men and women. The employment rates of older men and women remain high past age fifty, at 82 percent. In terms of hours, note that women work more than men – not counting housework -- at 2036 versus 1962 hours per year. Labor supply of the elderly is quite high, with annual hours only declining to about 1600, and with a slightly greater decline for women. The drop in labor supply for the elderly is small by North American standards, and consistent with a metaphor of ceaseless toil. Regarding the type of work, the majority of time for men and women of all ages is spent farming. The one age-related pattern is that the share of hours spent on the farm is higher for older individuals. What we cannot tell from this table, however, is whether this reflects “aging”, as older workers “retire” from off-farm jobs, or whether it reflects cohort effects, whereby older workers are less likely to have ever worked at a wage job.

3.3 Measuring health

How can we tell when someone’s health has “objectively” declined? Our main interest is capturing that part of health that is correlated with age, and possibly affects labor supply. The CHNS offers several possible health measures, each with well-known potential problems, and we outline some of the issues associated with each measure in turn. Because we use panel individuals, the need for continuity and comparability of the measures over the three surveys further constrains our choice of health measure.

Self-Reported Overall Health Status (SRHS)

Interviewers obtain SRHS by asking, “Right now, how would you describe your health compared to that of other people of your age.” Responses are then coded on a scale of one (excellent) to four (poor). SRHS is thus a subjective health measure. The CHNS collected SRHS in each wave, and it is the main health measure we use. On the positive side, SRHS may contain private health information that no doctor can measure. Previous evidence shows that SRHS has significant predictive power for subsequent mortality, even controlling for more objective health measures (Deaton and Paxson, 1998).

However, there are a number of potentially serious problems with SRHS.[9] First, respondents are supposed to "net out" the effect of age, so SRHS should be orthogonal to age. In principle, it should be an ineffective way to measure the deterioration of health with age. In practice, respondents do a poor job of adjusting for age, and SRHS is correlated with age (see also Deaton and Paxson, 1998). The effect of age on health may yet be understated, and combined with measurement error (and resulting attenuation bias), we could underestimate the contribution of diminished health to the retirement decision. Second, an individual's sense of health may depend on his labor supply. If someone is not working, he may justify or rationalize this by poor health, in which case we would mistakenly conclude that poor health reduced his labor supply. But this "justification bias" is only one reason why health may be endogenous to the labor supply equation. The interpretation or perception of self-reported health may be correlated with economic variables that determine labor supply (See Bound, *et al*, 1999). For example, richer individuals might have higher "standards" or benchmarks for good health. For two equally healthy people, we may find that the poorer one reports being in better health, while working more (or less). Depending on the correlation of these potentially unobservable variables with labor supply, we could under- or over-estimate the impact of health on labor supply. Third, SRHS may be a noisy indicator of underlying latent health, and our estimates may suffer from conventional attenuation bias. Fourth, the timing of observed health may not line up with the "retirement decision," though this problem applies to other health measures.

A number of strategies exist for addressing these problems. For example, other health measures can be used as instrumental variables. Alternatively, other health measures can substitute for SRHS, as a means of exploring the robustness of conclusions to SRHS. Previous studies, like Baker, Deri, and Stabile (2002), find that the measurement error bias outweighs the "justification bias", and their work points to the value of using instrumental variables in this setting. Panel data allows us to address other shortcomings of SRHS. If the subjective benchmark for health is an individual fixed effect, then fixed-effects (FE) estimation will allow us to sweep away this form of heterogeneity. By observing individuals over time, we may also be better able to link the timing of health shocks to labor supply.

[9] McGarry (2002) and Bound (1991) provide excellent reviews of these problems.

<u>*Body Mass Index (BMI)*</u>

A person's BMI is defined as his weight (in kilograms) divided by the square of his height (in meters). It measures "physical robustness", in the sense that someone with an especially low BMI may be frail, while a person with an especially high BMI is obese. We thus expect a non-linear effect of BMI on labor supply or other outcomes, and a potentially asymmetric effect of being too light or too heavy. Dora Costa (1996, 1998), for example, shows that a "U-shaped" relationship exists between BMI and a variety of health outcomes, like the number of chronic conditions, bed days, hospitalizations, and doctors' visits. In explorations with the CHNS, we find a similar "U-shaped" relationship exists between BMI and health outcomes, like mortality.

While objective, BMI is an imperfect health measure. First, it may be endogenous to labor supply: Individuals with higher valued economic characteristics may have "better" BMI's because of superior nutrition or health care. This would lead to omitted variables bias. Alternatively, BMI may be unresponsive to important changes in heath that affect work decisions: BMI will not reflect blindness or a bad back. One benefit of using BMI as a health measure is that it is commonly recorded in surveys, which permits comparison of our results with others. For example, BMI is the main health measure used by Dora Costa. BMI is also recorded in all the waves of the CHNS, so we can use it in our panel procedures.

<u>*Activities of Daily Living (ADL)*</u>

The ADL module of the CHNS is applied to people over fifty years old, and measures a person's ability to carry out a list of daily activities, like taking a bath, being able to eat and drink, using the bathroom, or dressing themselves. In principle, ADL's offer more objective information about health status than SRHS, and improve upon BMI by capturing functional limitations. Deteriorations of health reflected in ADL's may be directly related to those that affect labor supply. But ADL's have their own limitations, especially in the context of the CHNS. First, the measure is unavailable for individuals under fifty years old. Second, ADL's were not recorded in 1991. Third, ADL's are only designed to capture extreme disabilities. For the majority of the elderly who are not so frail, we have no health information to distinguish their health status (McClellan, 1998). People with diabetes, for example, may have no problem doing all the daily activities, but may decide to retire earlier. While we used ADL's in preliminary explorations, given the survey limitations, we do not use them in our primary analysis.

Physical Function Limitations (PF)

The CHNS asks a series of questions about physical conditions that can also be used, like ADL's, to construct an "objective" index of health. PF's do not measure behavioral abilities as ADL's, but indicate difficulties for specific physical functions associated with hearing, eyesight, use of arms, legs, etc. While the set of questions varies over surveys, a set of five questions (listed in the appendix) provides time-comparable information on the state of various bodily functions, including some related to the ability to work.[10] In order to distill the responses to these five questions into a single variable, we use principal components analysis to create a single index. PF's share many of the same pros and cons as ADL's for use in labor supply functions. Furthermore, the CHNS only has measures for 1991 and 1993. However, PF's have the advantage over ADL's of being recorded for everyone. We use the PF's as instruments for the SRHS, in order to address some of the shortcomings of SRHS described earlier.

Subsequent Death (Mortality)

One benefit of a longitudinal survey is that we can follow individuals over time. This means that we can observe outcomes -- like death -- that occur subsequent to an early survey year. Some aspects of health may not be observable to surveyors, or even the respondent, though underlying poor health may be reflected in labor supply, and eventual death. Previous researchers have found "subsequent mortality" a useful objective health measure.[11] We create an indicator of subsequent death, defined from the perspective of 1991, as whether the individual died prior to either the 1993 or 1997 surveys. As such, this measure is only available for 1991, and cannot be used in the panel analysis. However, it serves a useful role in cross-validating the other health measures.

3.4 Preliminary explorations with the health measures

[10] The choice of the grouping together of body functions – like heart, lungs, and stomach – into one category seems somewhat mysterious (and slightly amusing), and it is variation in this dimension that restricts comparability over time.

[11] See Parsons (1980), Hurd and Boskin (1984), and Anderson and Burkhauser (1985), for example.

Table 1 provides descriptive statistics concerning some of these health measures. We collapse the responses for SRHS into a single indicator of good health, *H12*, which takes on the value of one for a person reporting being in the top two categories. For all age groups, 74 percent of men, and 72 percent of women, report being in good health. The proportion declines with age, as only 58 percent of elderly men, and 53 percent of elderly women, report good health. The average BMI is similar for the full sample and the older sub-sample. However, this hides some deterioration in health, as a significantly higher proportion of elderly men and women have low BMI, defined as a BMI in the lowest 20 percent. By contrast, there is little difference in the incidence of high BMI, defined as a BMI in the highest 20 percent. While the units are meaningless, the indices for physical function problems (*PF*s) are higher in magnitude (more negative) for older individuals. Finally, the probability of subsequent death is much higher for individuals over fifty: Fully twenty percent of men over fifty in 1991 died by 1997. A much smaller fraction of older women died by 1997. This is largely a consequence of our sample selection, which is tilted towards younger women, and those with surviving husbands.

Table 2 reports the results of preliminary cross-section regressions to evaluate the informational content of the health measures. In the first panel, we explore the relationship between the health measures and subsequent death. Of most significance, *H12* is a statistically significant predictor of mortality across all specifications. Controlling for age, education, province dummies, and health measures like BMI and PFs, we find (like other researchers) that H12 contains important residual health information. We also find for men that worse PF's are significant predictors of subsequent death.[12] The second panel shows the results of a similar cross-section regression of hours worked on the health measures, controlling for age, education, and province. By far, subsequent death has the strongest predictive power, and the poor health it captures is negatively related to labor supply. This is our first evidence that "health matters" for labor supply, and moreover, "subsequent death" should not suffer from the measurement problems (like justification bias) described earlier. We also see that H12 is positively correlated with labor supply, and

[12] We scale the index of physical functions so that increases in the index reflect improvements in health. As a result, the signs of the health effects for PF and H12 should be the same.

statistically significant for older men. The sign patterns of the other health coefficients also make sense, but are not statistically significant.

3.5 Isolating age from cohort effects

The “pure” effect of age is not easy to estimate. Consider our labor supply function:

$$L_{it}^{M} = \beta_0 + \beta_1 A_{it}^{M} + \beta_2 h_{it}^{M} + \varepsilon_{it} \tag{17}$$

The age coefficient (β_1) will be biased if there are factors in ε_{it} that are correlated with age. In particular, birth cohort or “generational” effects may be important, especially for life-cycle behavior. In that case:

$$\varepsilon_{it} = \lambda_c + \omega_{it} \tag{18}$$

where λ_c represents the fixed labor supply pattern of individuals born in cohort *c*. Goldin (1990), for example, shows how cohort effects contaminate traditional cross-section age-participation profiles. The key question is whether today’s sixty year olds are good predictors for the labor supply of today’s fifty years olds, ten years from now. In a growing economy with declining retirement ages, a cross-section age-profile might underestimate the effect of age on labor supply.

The solution is to follow birth-cohorts over time in order to trace more accurately the effects of age. This can be accomplished by including cohort fixed effects in a pooled time-series cross-section specification. With panel data we can go one step further by including individual fixed-effects. This has the additional benefit of absorbing individual heterogeneity that may be correlated with age, work, or health status. For example, individual “benchmarks” for subjective health can modeled as fixed effects, in which case the fixed-effect specification will adjust for differences across individuals in their perception of permanent health. Furthermore, the fixed effects will absorb some of the otherwise unobservable economic variables, like wealth or long-run productivity, that could also be correlated with health.

In the specifications that follow, we report both fixed-effects (FE) and random-effects (RE) results. The fixed-effects specifications have the advantage of being robust to the problems just described. On the other hand, the FE results may themselves be biased by the amplification of measurement error in our health measures. Furthermore, the RE estimator admits cross-cohort variation in health and labor supply, which may provide (with appropriate qualifications) a useful source of identification.

3.6 Attrition

While panel data has its advantages, there are built-in problems because of attrition. By restricting our analysis to those individuals who actually survived the 1991-1997 survey cycle, we can actually bias the age and health coefficients if:

$$\operatorname{cov}\left(E[v_{it}, u_{it}, \varepsilon_{it} \mid survive], A_{it}^{M}\right) \neq 0 \tag{19}$$

This happens when only healthy or hard-working people live to old age, in which case, we understate the relationship between age and deterioration of health, or the reduction of labor supply. There is little we can do to address this bias, besides documenting the extent of attrition, and being aware of situations (which we will see) where it is likely to be a problem. The appendix provides the first ingredient, with a table documenting the extent of attrition relevant in the construction of our working sample.

4.0 Results

4.1 Non-parametric explorations of lifecycle work and health

Figures 1 through 4 provide non-parametric estimates of the relationship[13]:

$$y_i = g(Age_i) + \phi_i \tag{20}$$

Where y_i refers to either (i) Hours of work; (ii) Participation (positive hours worked); (iii) Good Health (H12=1); or (iv) The fraction of hours spent working off-farm. In each figure we present the cross-section age-profile for men and women for survey year 1991. In order to evaluate whether cross-section profiles are accurate predictors of intertemporal behavior, we also show estimates of:

$$\Delta y_i = f(Age_i) + \varphi_i \tag{21}$$

[13] We use the Fan (1992) estimator, described in detail (with examples) by Deaton (1997).

In this case, we look at the *ex post* change in work and health from 1991 to 1997 for each person arrayed by his age in 1991. We then compare the predictions based on the cross-section with what actually happened.

Figure 1 illustrates "ceaseless toil" more clearly than any result in this paper. The top panel shows that the age-hours profile for men is much flatter than in developed countries. On average, seventy-year old rural Chinese men work almost 1000 hours per year, about half their peak labor supply of 2000 hours per year. Hours begin to decline after age forty, and the only evidence of retirement is this gradual decline in hours worked. A similar pattern holds for women, though "retirement" is more pronounced: seventy-year old women work an average of 500 hours per year, approximately one-quarter of their peak labor supply of 2000 hours.

The bottom two panels allow us to gauge the possible impact of cohort effects, by comparing the predicted changes implied by the cross-section to what actually happened between 1991 and 1997. Take the example of fifty-year olds. The 1991 cross-section suggests that hours will drop from 2000 to 1500 hours between ages fifty and sixty. These prediction may be wrong, however, if there are permanent differences in life-time hours between fifty and sixty year olds in 1991. For example, if fifty year olds in 1991 are richer than those who were fifty in 1981, then their hours may fall more than predicted. More specifically, we can use the 1991 cross-section to predict the change in hours associated with six years of aging (from 1991 to 1997). The predicted change is given by the dashed line in the middle panel. For fifty-year olds, we predict a decline of approximately 200 hours. As the solid line shows, however, their actual hours dropped by 700! Perhaps this reflects a significant shift towards "early retirement." But a quick glance at the changes for other ages casts doubt on that interpretation. Instead, there is an approximate 500 hour difference between the actual and predicted change in hours, common to all ages. This is more accurately described as a "year effect."

Why did hours decline so much for everyone? We explored a number of possible explanations. Almost all of the decline in total hours is due to reductions in time spent farming. Possibly the survey question is different in 1997 than 1991? However, the question is identical in the surveys. This does not preclude the possibility of different instructions being given to the enumerators. However, it is striking that the decline is so uniform across provinces and age groups. We were also unable to line up the change in hours with observable economic variables, like wages or crop prices.[14] A similar decline in hours, albeit smaller in magnitude, is also seen in RCRE rural household survey data.[15] Whatever the explanation, we have no reason to believe that this uniform drop in hours substantively affects our interpretation of the impact of age on labor supply. We agnostically label it a "year effect," noting however, that we make no attempt to disentangle (identify) the possible year and cohort effects. Our main concern is that the cross-section provides a poor estimate of the effect of age on labor supply, which will be reflected in non-parallel differences between the predicted and actual change in hours. In fact, the bottom panel suggests that the difference between predicted and actual changes is unrelated to age, so cohort effects may not be a problem in this case.

Cohort effects may be a more serious problem for women's age profiles. In addition to a possible shift towards early retirement, the changing economic role of women might render the cross-section misleading. As is the case for men, the cross-section overpredicts hours worked in 1997, consistent with a year effect of 500 hours. For women, there is more correlation of the gap with age, i.e., the actual change in hours is not a simple parallel shift of predicted hours. The drop is slightly smaller for younger women, consistent with increased labor supply by women in their early twenties. But the gap is actually smallest for older women, meaning women worked relatively *more* than predicted, once we account for a common year effect. Whatever this reflects, it does not appear that there is a trend towards early retirement for women in China. If the already strong attachment to work can be called "ceaseless toil," it shows no sign of abating.

Figure 2 plots the corresponding results for participation, and allows us to evaluate the extent to which there is a discrete withdrawal from work. The participation figures should also be robust to some of

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[14] One possibility is that reported hours in agriculture now more accurately conform to "hours worked", rather than time spent "idle" on the farm. As Benjamin and Brandt (2002) show using a different Chinese survey, there appears to be a great deal of inefficient time spent in "farming" which appears to decline as economic opportunities improve.

[15] The RCRE data imply a reduction of labor supply to farming of just under twenty percent between 1990 and 1997.

the measurement issues that may afflict hours. However, the overall picture that emerges for participation is similar to total hours. Men and women both have a high rate of participation, which only gradually declines at age fifty. By age seventy, over half of men and women are still working.

Concerning possible cohort or year effects, the middle panel for men shows that the drop in participation is greater than predicted between 1991 and 1997, just less than 10 percentage points. For the youngest workers, the increase in participation was about 10 percent less than predicted, but for prime age workers (between 35 and fifty), the gap was much smaller. This pattern by age is not consistent with a common year effect, though the correlation of the gap with age may not be statistically significant. The bottom two panels for women tell a similar story to Figure 1. Participation dropped more than predicted (between 5 and 10 points), but the gap is neutral with respect to age. If anything (as with hours), older women's participation decreased less than other ages.

Figure 3 addresses the type of work done over the life-cycle, particularly whether people shift towards farm work. The top panels show that older men and women are less likely to work off the farm, spending a smaller fraction of their hours in non-agricultural activities. However, if there are trends across cohorts towards off-farm work, we expect the age profile to be contaminated by cohort effects. In the middle panel, we see that the cohort effects are quite pronounced for middle-aged men. The cross-section predicts that forty year-old men would drop their share of hours off the farm by more than 5 percent, but instead they increased their relative time off the farm. For older men, the actual drop exceeded that predicted by the cross-section. The figures for women highlight the growing importance of non-farm work. Women of all ages increased their share of work off the farm, contrary to the prediction of the cross-section. Apparently, the cross-section age profile is mostly a "cohort," not "age" profile. Concerning retirement, there is no evidence that older women shift to farming from non-agricultural pursuits.

Figure 4 shows the age profiles for our health variable, H12. These graphs particularly illustrate the difficulty of disentangling age from cohort effects, and also the potential biases introduced by attrition. We might expect to see a steady deterioration of health with age that lines up with the decline in hours seen in Figure 1. The top panels for men and women suggest this is the case. About 90 percent of twenty-year old men, and 80 percent of twenty-year old women report being in good health, compared to 60 percent of sixty year old men, and 40 percent of sixty year old women. Note the slight "uptick" in health for seventy year old men, suggesting that health actually *increases* with old age. A more plausible explanation is that the otherwise unhealthy men are dead by age seventy, and only the healthy remain to answer the survey. This is prototypic selection bias that can result from attrition.

In an economy with rapidly rising incomes, health is expected to improve with time. Younger cohorts may be permanently healthier than older ones, in which case, the cross-section age profile is a misleading predictor of the evolution of health with age. In fact, the cross-section and longitudinal data line up for most ages, except the oldest age groups, where attrition bias is worst. The health of sixty-five year old men deteriorated much more than predicted by the cross-section. But note the scale of health deterioration: Only 2.5 percent of fifty-year old men, and 7.5 percent of sixty year old men saw their health status fall. If retirement is driven by declines in H12, then it will have to be the case that health has a large effect on labor supply, given how few elderly report declines in health.

4.2 Reduced-form age effects

We now provide more precise estimates of the age profiles. The regressions are slight variations on (14), with controls for years of schooling (EDU), province dummies, and year dummies:

$$\begin{aligned} L_{it}^{M} &= \beta_0 + \sum_{j=1}^{J} \beta_{1j} AGEG(j)_{it}^{M} + \beta_3 EDU_{it} + \beta_4' PROV_{it} + \beta_5' YEAR_{it} + v_{it}^{M} \\ h_{it}^{M} &= \delta_0 + \sum_{j=1}^{J} \delta_{1j} AGEG(j)_{it}^{M} + \delta_3 EDU_{it} + \delta_4' PROV_{it} + \delta_5' YEAR_{it} + u_{it}^{M} \end{aligned} \tag{22}$$

We report the estimated change in labor supply associated with aging from fifty to sixty years old ($\Delta_{5060}^{L} = \beta_{1(60-65)} - \beta_{1(50-55)}$), and sixty to seventy, $\Delta_{7060}^{L} = \beta_{1(70-75)} - \beta_{1(60-65)}$, with the analogously defined health profile, $\Delta_{5060}^{h}, \Delta_{6070}^{h}$. Equation (22) is estimated by fixed and random effects. Note that the inclusion of year effects accounts for the overall drop in hours between 1991 and 1997 for both the RE and FE specifications. We also report Hausman-Wu tests for the equality of the FE and RE estimates of the individual age effects (e.g., Δ^{L}_{7060}), as well as the joint test of the entire RE specification (versus FE).

The top panel of Table 3 presents results for men. Looking at the first row, the RE estimate shows a significant decline of 356 hours per year between age fifty and sixty: older men work less. However, the FE estimate shows hours actually increasing by 79 from age fifty to sixty, though the increase is not statistically significant. Apparently, the fact that sixty year olds work less than fifty year olds reflects longer run differences in labor supply across cohorts, not the genuine effect of aging: men's hours do not decline between fifty and sixty. The corresponding Hausman-Wu test indicates that the difference between the RE and FE estimates is significant, and we should thus prefer the FE results. The two estimators line up more closely for changes between age sixty and seventy, suggesting statistically significant declines in hours worked of about 500 per year. The second row reports the results for participation, which mirror those for hours: there is no "retirement" from age fifty to sixty, but labor supply drops between sixty and seventy. The results for health are in the next three rows. While there are apparent declines in health reflected in the RE estimates, there does not appear to be any significant decline in health – whether we measure it by H12 or extreme BMI – as people age, once we control for individual fixed effects.

The results for women are quite similar. We find no evidence of reduced hours using the FE estimator, although there are differences in hours across age groups using the RE estimator. From ages sixty to seventy, we do see a significant decline in participation, and as with men, this is our most robust evidence of retirement behavior. Similar to men, we find no systematic declines of health with age, controlling for fixed effects.

4.3 Structural estimates and decompositions

We now explore the possible connections between health and labor supply, and provide the "bottom line" decompositions, $\beta_2 \times \Delta^{h}_{6050}$ and $\beta_2 \times \Delta^{h}_{7060}$. The structural equation is based on (15):

$$L_{it}^{M} = \beta_0 + \sum_{j=1}^{J} \beta_{1j} AGEG(j)_{it}^{M} + \beta_{2M} h_{it}^{M} + \beta_{2F} h_{it}^{F} + \beta_3 EDU_{it} + \beta_4' PROV_{it} + \beta_5' YEAR_{it} + \varepsilon_{it}^{M} \qquad (23)$$

where we wish to identify the effect of own and spouse's health on labor supply, β_{2M}, β_{2F}. The coefficients for men are presented in Table 4, and those for women are in Table 5, while the decompositions are reported in Table 6.

For men, Table 4 shows that the RE (non-instrumented, "OLS") estimate of H12 on labor supply is a small, but statistically significant 161.8 hours per year. If a fifty-year old's health (H12) declines by 0.097 by age sixty, then as Table 6 documents, we can account for only 15.7/356 of the corresponding decline in hours. Even for aging between sixty and seventy, we only explain 11.9/542 of the drop in hours. These estimates suggest that declining health has nothing to do with retirement. The FE results tell the same story, with none of the decline between fifty and sixty explained by health, and only 11.3/453.8 explained of the change in hours between sixty and seventy. Turning to spousal health, wife's health has a statistically significant impact on hours, consistent with an "added worker" effect: if a man's wife experiences a decline in health, he increases his hours of work. Table 4 also shows the results for BMI. Only in the FE specification (which nets out "normal health") does low BMI have a non-trivial impact on hours worked. However, the conclusions from the decompositions do not change: declining health does not explain retirement.

However, the health coefficients may be biased because of the endogeneity of H12. Especially, given the possible attenuation bias caused by measurement error, it is worth investigating whether we are understating the role of health.[16] To address the possible measurement error in using H12 as the health variable, we use the "objective" physical function limitations (PF's) as instruments, and report the 2SLS results alongside OLS.[17] Essentially, by instrumenting H12, we emphasize that part of self-reported health that is driven by changes in "objective" physical functions that may be correlated with labor supply. The

[16] See Baker, Deri, and Stabile (2002), for example.

[17] Recall that PFs are only available for 1991, 1993. For purposes of comparison, we could add a third set of estimates: OLS for the 1991, 1993 sample. However, the results are essentially the same as for 1991-1997 (with smaller standard errors). We are thus confident that the differences between the reported OLS and IV coefficients are due to bias in OLS, as opposed to the smaller 1991-93 sample.

2SLS coefficients are much larger. For RE, the estimated H12 coefficient increases by a factor of six, while for FE, the coefficient increases fifteen times. This has a significant effect on the the decompositions reported in Table 6. For the younger men (aging from fifty to sixty), the RE estimate is 104/356, while the FE estimate remains at zero. Even with a higher estimated impact of health, the FE estimate shows no decline in health with age between fifty and sixty. For aging between sixty and seventy, however, we explain a much higher fraction of the decline in labor supply. The RE decomposition yields 79/542 hours, while the FE result is 208/453. If we take the instrumented FE coefficients as our preferred results, about 45 percent of the decline in hours between sixty and seventy is explained by declining health.

The bottom panel of Table 4 shows the results for participation. The sign and statistical significance patterns are similar to those for hours, except that only the RE estimates are statistically significant. If we again take the FE-IV results as the preferred estimates, we cannot explain “retirement” (the discrete withdrawal from working) by changes in health. Deteriorating health has a larger impact on hours worked than on participation.

Tables 5 reports the coefficients for women. The “OLS” estimates of own-H12 are quite small, and statistically insignificant. The only significant own-H12 effects are in the instrumental variables (IV) RE specification. In this case, 121/431 (for fifty to sixty) and 149/382 (for sixty to seventy) of the decline in hours can be explained by failing health. In contrast to their husbands, the link between own-health and labor supply is very weak. Possibly, this suggests that other factors—like economic variables—are more important for women. The spousal effects, however, are much stronger for women, and the estimated coefficients on spouse health are about twice as high. A wife’s labor supply is more elastic with respect to her husband’s health, and women work more if their husband is sick.[18] But, the most notable result pertaining to women is the small role that their health plays in explaining work patterns with age.

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[18] See Berger (1983), and Berger and Fleisher (1984), for other evidence that spousal health is a significant determinant of labor supply.

In summary, to the extent that we regard "ceaseless toil" as working until it is no longer physically possible, it is only for men as they age from sixty to seventy that we can attribute much of the change in labor supply to observable declines in health. We do find statistically and economically significant estimates of the effect of individual health on labor supply for the other age groups: it is just that we do not observe declines in health with age that line up with hours.[19]

5.0 Extensions

5.1 The role of household wealth

To this point, our results suggest only a modest role for health in explaining retirement, especially for people in their fifties. Perhaps other variables are more important. Of most interest are "income" and "wealth," as these potentially capture the key differences between Chinese elderly and their counterparts in rich countries. Indeed, low income is a key element in Davis-Friedmann's original portrait of the Chinese elderly, and their need for ceaseless toil. Income was also the main factor highlighted by Costa (1998) in explaining trends towards earlier retirement in the United States over the twentieth century.

While we would like to estimate a fully specified labor supply model in order to assess the role of economic variables in the retirement decision, the inability to measure the individual-level marginal returns to work makes disentangling income from substitution effects impossible. We conduct a simpler exercise instead — even if the evidence is only suggestive – to contrast the retirement behavior of "rich" and "poor." To do this, we construct a measure of household wealth, comprised of productive assets (5%) like farm machinery and draft animals, and non-productive wealth, like housing (78%), transportation

[19] One possibility is that we diluted the impact of health on labor supply by pooling young and old, with the same health coefficient. In the appendix, we replicate Tables 3-6 for an older sub-sample, 40 years and older. While the estimated health effects are slightly larger (as expected), they do not change the story. A more serious concern is that we underestimate the decline in health with age, possibly due to attrition bias. Even with attrition, however, we expect the cross-section to be more biased than the fixed-effects panel in detecting declines in health with age. This does not preclude the possibility, however, that part of the low explanatory power of health for retirement (on average) is that we have a disproportionately healthy, surviving sample.

equipment, livestock, and consumer durables.[20] In the regressions that follow, we use the log of per capita household wealth as the wealth measure and interact it with the age and health variables.

What might we expect? As Costa (1998) notes when discussing a similar exercise (she finds no significant interactions), the *a priori* effect of wealth (or income) on the response of labor supply to health is ambiguous. On one hand, wealth may facilitate the reduction of labor supply in response to an adverse health shock. If a household is rich and the husband does not feel well, he can more comfortably reduce his labor supply (i.e., his "marginal utility" of leisure may be higher than a poor person, who more highly values consumption). On the other hand, higher income may reduce the linkages between health and labor supply, as Costa suggests occurred in North America. In this case, the income effect of higher wealth dominates, and health is a minor determinant of the retirement decision: only the poor work until poor health stops them.

Table 7 shows the age profiles with the interactions with wealth.[21] Our focus is on the sign and statistical significance patterns of the interactions with age and health. Looking first at the columns for men, a few suggestive conclusions emerge. First, the coefficient on wealth itself is positive, suggesting that those who are richer work more (and illustrating the typical problem of identifying income effects in labor supply regressions). However, the declining age profile for men after age 55 is significantly steeper with greater wealth. If we define retirement as a *reduction* of labor supply, it seems that wealth facilitates retirement. However, the wealth effect is not so strong as to imply that richer men enjoy more leisure in old age – merely they "slow down" more. For own health, the interaction term is negative, which is consistent with income weakening the link between health and labor supply (similar to Dora Costa's finding).

[20] By far the most important source of wealth is housing. All households were surveyed in 1991 about the value of their house. This is the value of housing we use in calculating wealth for all years, except for those households who reported they moved, in which case an updated house value was recorded. For households with missing housing values, we imputed the value of the house using a hedonic regression including housing characteristics (e.g. square footage, building materials, year of construction).

[21] As in the other tables, we report the RE and FE results. In this case, we only report the "OLS" (non-instrumented) specifications.

The results for women provide an interesting contrast. The age profile is similar to their husband's: richer women work more overall, and have steeper declines in hours after age fifty. But the health-wealth interaction effects are the opposite of the men's. There is a significant positive interaction term, so that as income increases, the sensitivity of labor supply to health also rises. Own-health matters more for richer women, meaning if they suffer an adverse health shock, they can more readily reduce their labor supply. The cross-health effect (for husband's health) is also highly dependent on wealth level. The negative interaction effect implies that richer women with healthy husbands are less likely to work (or work fewer hours). This is consistent with the link between health and labor supply weakening with wealth. Certainly, the results of own and spousal health-wealth interactions suggest that women have more elastic labor supply to these income earning activities.

5.2 Living arrangements

Another form of possible wealth is the potential transfers that can occur within a family. To the extent that informal transfers, including extended household living arrangements serve as social security, it would be interesting to evaluate whether retirement is facilitated by the existence of "private social security." For example, one could compare the retirement patterns of individuals living with adult children to elderly living alone or with their spouses. In a previous paper (Benjamin, Brandt, and Rozelle, 2000) we describe in considerable detail the evolution and nature of living arrangements for the elderly. While we find significant declines in extended families for the elderly, we do find some evidence using a different data set, that the elderly in extended households work less than those living on their own, at least approaching age seventy. However, as we emphasize in that paper, it is very difficult to estimate the causal effect of living arrangements on any economic outcome. It could easily be the case that elderly move in with their children as their health fails, or they are unable to work for themselves. In such a case, we cannot tell how much the extended family itself facilitates "retirement."

With this caveat, we replicated that exercise, interacting an indicator for "extended family" with the age and health profiles, as we did for wealth in Table 7. Our results (not shown) suggest no significant difference in coefficients for those elderly living with adult children. While we would have expected the endogeneity of family structure to generate significant coefficients, we still regard our conclusions as tentative. A more complete investigation of the determination of living arrangements (along the lines of Cameron (2000), for example) is clearly merited. Unfortunately, the CHNS is not well suited to this type of analysis because it does no record information on non-resident children, and this data is critical to predicting living arrangements. For our immediate purposes, however, we find no evidence in the CHNS that extended family arrangements affect any of our conclusions or interpretation. Besides, to the extent that extended family living arrangements are disappearing, they are not likely a source of social security that the elderly can count on.[22]

5.3 Household income

One possible interpretation of our findings is that current cohorts of Chinese elderly are too poor to retire: Despite generally rising rural living standards, there is no sign of a move towards earlier retirement. Our explorations with wealth confirm that household economic conditions do, indeed, interact with age and health in determining the labor supply of the elderly. We now turn to household per capita incomes. Our investigation serves two purposes. First, we document the structure of income for the elderly, which allows us to see how the earned income from work fits into the bigger picture. We can also compare the welfare levels of elderly and non-elderly individuals. Second, while we cannot establish causal links, we can evaluate whether elderly living standards are consistent with the economic interpretation of "ceaseless toil."

Table 8 reports mean income by source, where we attribute household per capita income equally to each member of a household. Looking first at the results for men, we see that men over sixty had lower incomes than prime-age males in 1991, and this gap widened by 1997. The absolute incomes of the older men increased only marginally over this time period, while the younger groups gained significantly. Crop income represents one quarter of total income, and is declining in importance. This highlights the limitations for farming alone to provide sufficient earnings for the elderly, and would look even worse

[22] There is also doubt that financial transfers from children to elderly can significantly reduce the need for the elderly to work. See recent work (on Indonesia) by Cameron and Cobb-Clark (2002).

with more recent data reflecting even lower crop prices. The "other income" category, which includes remittances, is quite important for the elderly, and increased between 1991 and 1997. While this offers some hope that private transfers can off-set reductions of income from earned-sources, clearly, these transfers are only high enough to keep elderly incomes at the 1991 level. The results for women are similar to the men, though their relative position appears lower.

In Table 9 we report more formal estimates of the income-age profile, similar to those in the previous tables.[23] From age fifty to sixty, we estimate no decline in income for men, in either the FE or RE specification. For women, we find that the FE estimates are significantly more *negative* than RE. This suggests that the "pure" aging effect is worse than the apparent RE estimate, which would be the case if cohort living standards are actually *declining* (relative to the young) for the elderly. For aging between sixty and seventy, we also find significant declines in income for both men and women, with the FE estimates more negative than the RE. Again, this is consistent with declining (relative) cohort living standards, and may be part of the reason—or another reflection—that retirement ages have not fallen over the 1990s.

The drops in income are greater in percentage terms than the declines in hours, especially from age sixty to seventy. This possibly suggests that productivity (as measured by income per hour worked) declines with age. Perhaps this explains the drop in labor supply? Maybe the life-cycle model has more content than previously believed, and retirement behavior is the movement along an inter-temporal labor supply function in response to falling (shadow) wages? Such an interpretation would be a stretch in this case (and others, as documented by Card (1994)). Without more formal modeling (with highly restrictive assumptions), it is impossible to identify a causal link between productivity and hours worked. A less optimistic interpretation is that hours decline for other reasons, and in concert with reduced productivity,

[23] We also explored linkages between health and income, along the same lines we did for labor supply. The bottom line is that we found no statistically significant link between health and income. These results need to be treated with extreme caution, however, as health is likely even more endogenous to an income equation than labor supply. In fact, it would be quite reasonable to estimate the regression in reverse (health as a function of income) See Case, Lubotsky, and Paxson (2002) for a recent discussion and survey of interpretation issues concerning the income-health relationship. While their paper addresses child health, the identification problems in disentangling the direction of causality between income and health are discussed, and a rich set of references is provided.

income falls proportionately more. Even though we cannot establish a causal link between income and hours, given the grim age pattern for income, our observation of ceaseless toil should come as no surprise.

6.0 Conclusions and discussion

The main purpose of our paper has been to evaluate whether Davis-Friedmann's metaphor of ceaseless toil has empirical content in post-reform rural China. Our analysis focused on two important correlates of labor supply: age and health. To assess their role, we exploit panel data (or repeated cross-sections), which are indispensable to disentangling age from potential cohort effects. Regarding age, our evidence shows that the toil is indeed "ceaseless": many elderly continue working through old age, even past age seventy. As for health, we estimated the degree to which "retirement" is driven by failing health. Under ceaseless toil, we might expect health to be the primary determinant of retirement, as the elderly cannot afford to retire. We found that declining health can explain just under half of the reduction in hours for men as they age between sixty and seventy years old. A decline in health is also responsible for reducing the hours for women from age sixty to seventy, but other factors offset this, so that their hours were actually unchanged with age. Moreover, we also found that that women's labor supply is responsive to their husband's health: women work more as their husband's health fails.

In further support of a "ceaseless toil" interpretation, we found that wealth appeared to facilitate retirement for men, weakening the impact of health on the retirement decision. We also found that the effect of spousal health on women's labor supply was smaller in richer households. Finally, our explorations of household income-age profiles highlighted the stagnation of elderly incomes, despite real growth of household incomes for younger ages. Although we cannot make a causal link, these low incomes are consistent with the notion that elderly keep working in order to support themselves. Certainly, most of their household income comes from earned sources (as opposed to remittances from their children).

Current Chinese policy towards the rural elderly has two components: (1) As with everyone else in the village, allocate land to the elderly for them to work; and (2) Hope (and expect) that children will take care of their elderly parents. The first amounts to "almshouse support," especially with the recent collapse of crop prices, which has significantly reduced the returns to farming. Nor is there much evidence that the second is working. Certainly, elderly incomes are not "high enough" to permit retirement, and elderly incomes have not kept pace with those of the young.

Clearly, an important avenue of future research is the likely role that the family will play in the private provision of social security in the countryside. Will shared living arrangements continue to decline, especially with pressure for children to migrate to cities (the few children that there are)? How much can we expect remittances to offset the decline in implicit transfers that occur though living together? Alternatively, will the elderly and their adult children be allowed to migrate together to the cities? But at this point, it would seem that rural elderly deserve attention in any proposed reform of China's public pension system, though the possible interaction between a public system and the existing private one will have to be considered (e.g., Cox and Jimenez, 1992).

An important input in any policy discussion ought to be a comparative analysis of social security reform in other Asian countries. Recently, Taiwan significantly overhauled its old age security system, including the introduction of a scheme for farmers, as did South Korea. Japan, on the other hand, has long provided benefits for rural elderly. In all three countries, the rural elderly also likely benefited from agricultural protection, which served to raise rural incomes in the farm sector. China's recent entry into WTO precludes such an option. However, it may turn out that other mechanisms – besides a fully developed public pension system (but not including agricultural protection!) – may be a more feasible alternative for the Chinese as well. As a rural public pension scheme is not likely any time soon, the impact of other rural policies on the elderly needs to be revisited. For example, does it make sense to restrict village-level household transfers to land (as opposed to cash)? Does the current property right regime discourage the development of land rental markets, which provide an alternative way for the elderly to convert their land allocation to income? Or, do restrictions on land ownership inhibit savings, especially since it is likely the elderly who will remain in the countryside in the future? In the meantime, Davis-Friedmann's "ceaseless toil" is the likely prospect for China's elderly.

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8.0 Appendix

8.1 The CHNS sample and patterns of attrition

The first wave of the CHNS was carried out in 1989, with subsequent waves in 1991, 1993, 1997, and 2000. The wage income and health data are problematic for 1989, so we use th1 1991-1997 data (the 2000 data are not yet available). The sampling pattern of individuals, households, and communities for the CHNS from 1991 to 1997 is summarized in Table A1. Of 143 communities surveyed in 1991, only 108 survived through all subsequent waves, primarily because Liaoning province was dropped, and "replaced" Heilongjiang in 1997.

The attrition rate increases with the unit of observation, being smallest for communities, and highest for individuals. Just under two-thirds (61%) of households, but only 46 percent of individuals were surveyed in all three years.

As a simple summary of the characteristics of individuals who attrited from the 1991 sample, we estimated a linear probability model of whether an individual is in our panel sample (which also includes people who died and are accounted for). The results are as follows:

Linear Probability of Remaining in Sample for 1991-1997

Gender	edu	h12	lnpcy	a1019	a2029	a3039	a5059	a6069	a7079	a80
-0.11 (11.1)	-0.01 (6.3)	0.00 (0.0)	-0.02 (2.8)	-0.11 (7.5)	-0.22 (13.6)	-0.01 (0.6)	-0.02 (1.1)	-0.04 (1.9)	-0.04 (1.3)	-0.12 (2.3)

Notes:

1. Sample Size is 7830.
2. The dependent variable is an indicator of whether an individual remains in the sample all three years (or dies and is accounted for);
3. The sample includes all men and women in 1991 aged 10 years and older;
4. The absolute t-statistics are reported in parentheses.
5. The regression also includes dummies for the 125 communities, the F-statistic for which is 24.7, which is highly significant.

These results suggest that younger individuals (especially age 20 to 29 in 1991) were least likely to remain in the panel, as were those over 80 years old (who presumably died, but their deaths were not recorded in subsequent surveys). More educated individuals, and to some extent, those from higher income households were also most likely to leave the sample, probably though migration. Women were also more likely to leave the sample, as it is the custom for women to marry outside their village. As far as health is concerned, it does not appear that there is any correlation between health and attrition (conditional on our including subsequent deaths in our sample).

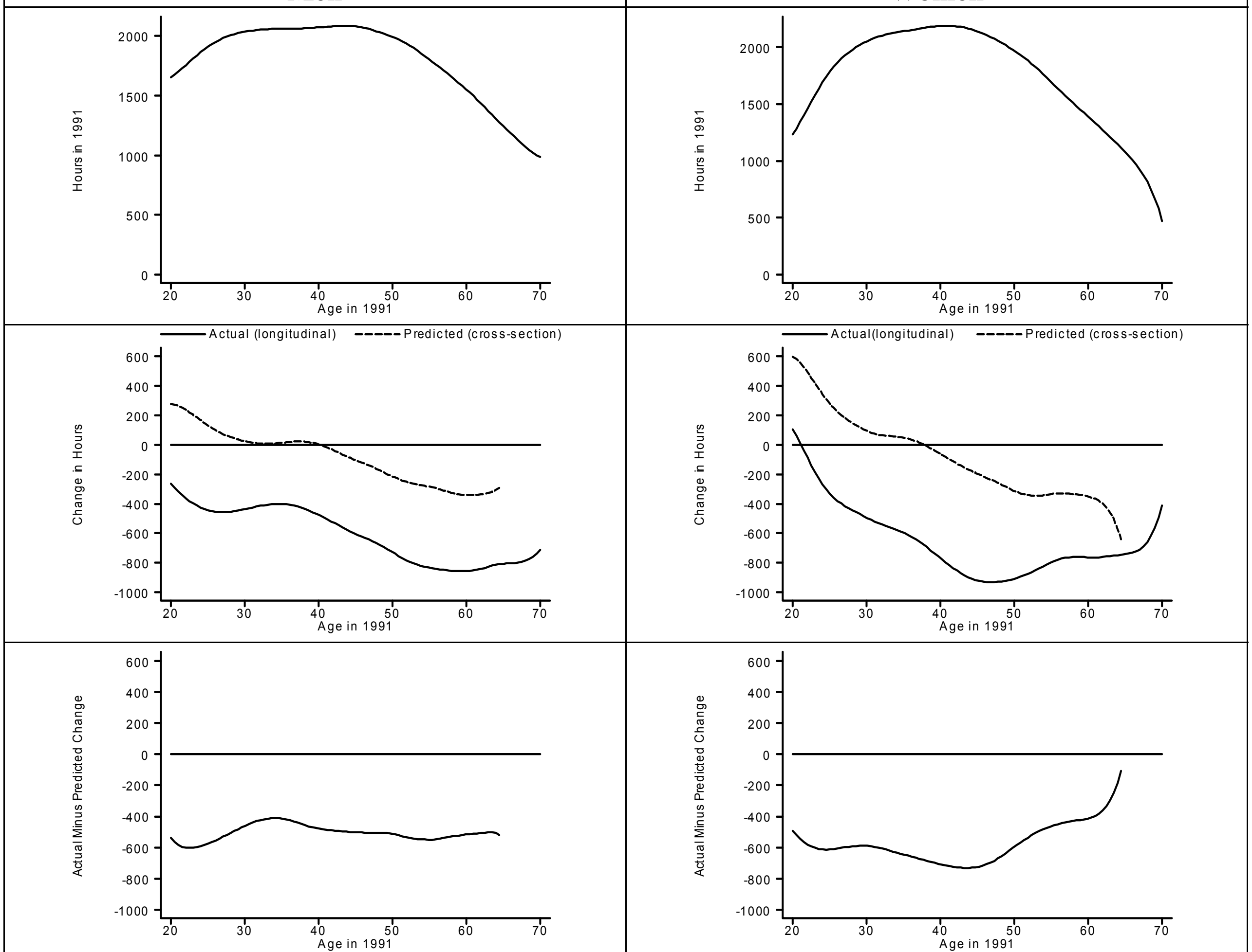
8.2 Definitions of physical functions

The following table summarizes the five CHNS questions pertaining to physical function limitations that we can use (comparably) for 1991 and 1993:

Question	Answers
How is the present condition of your heart, your lungs, and your stomach?	1. normal. 2. occasionally affect daily activities and work 3. frequently affect daily activities and work. 4. unable to carry out daily activities and work.
How is the present condition of your upper extremities, shoulders, upper back, and neck?	1. functioning normally. 2. having some problems, but not affecting daily activities and work. 3. slightly affecting daily activities and work, some degree of help is needed. 4. affecting daily activities and work, help is required.
How is the present condition of your lower extremities and spinal cord, and does this affect your walking?	1. functioning normally. 2. having some problems, but can still walk alone. 3. needing some help walking. 4. cannot walk, confined to bed, using wheelchair, or carried by others.
How is the present condition of your hearing, eyesight, and speaking?	1. functioning normally. 2. wearing glasses, hearing aid, or having some loss of ability. 3. deaf in ear, blind in one eye, some loss of speech, or serious loss of vision, hearing or speech. 4. completely deaf, blind, or unable to speak.
How is the present condition of your urine control and bowel control?	1. normal. 2. nighttime or occasional loss of urine or bowel control. 3. frequent loss of urine or bowel control. 4. total loss of urine or bowel control.

Figure 1: Annual Hours Worked by Age in 1991

Men	**Women**



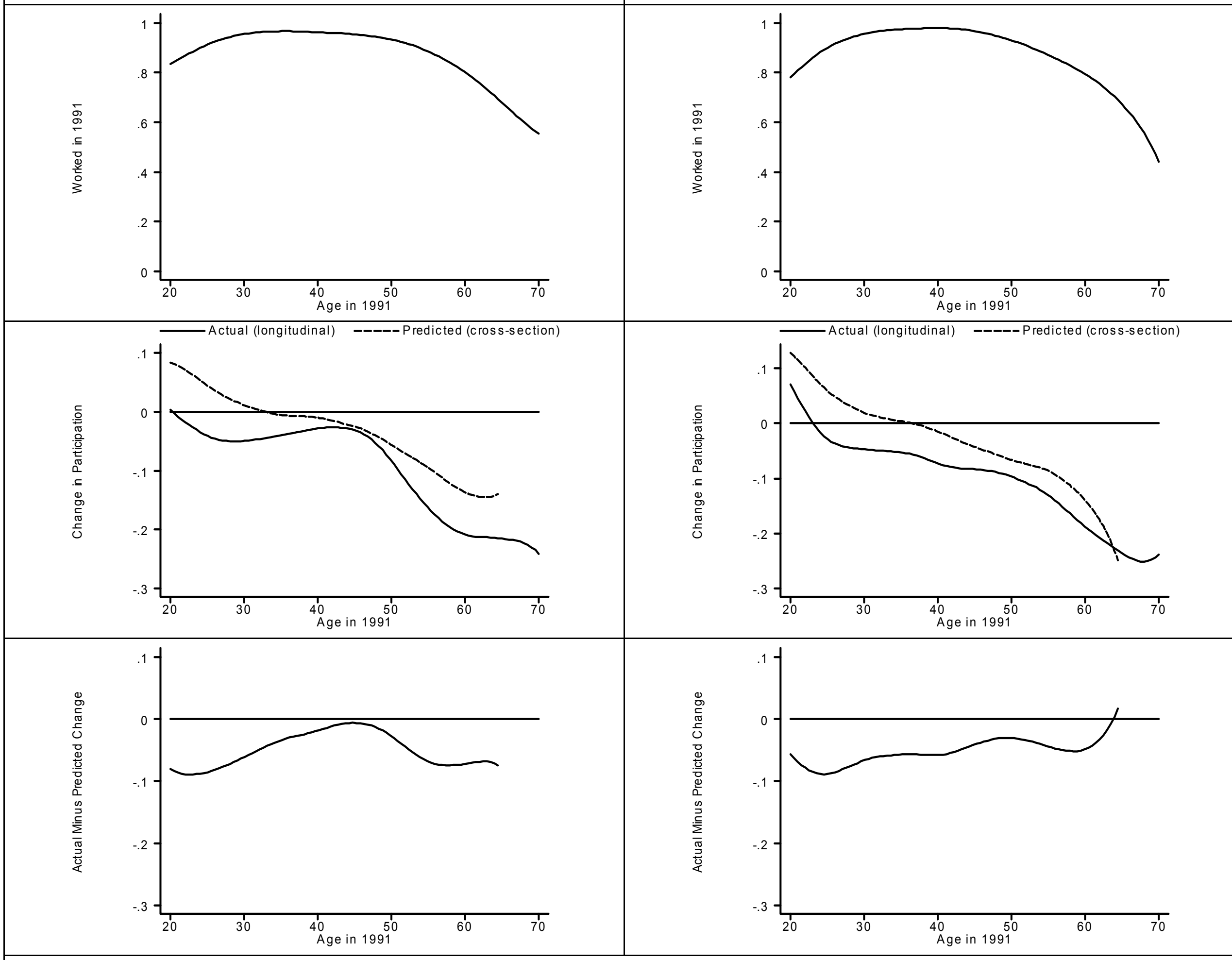
Source: CHNS, 1991,1993,1997

Notes:

1. Each figure represents a non-parametric simple regression of the dependent variable (“y-axis”) against the independent variable (“x-axis”);
2. The top panels show the 1991 cross-section relationship between hours (including zeroes) and age, while the bottom panels follow the panel households between 1991 and 1997, plotting the changes in hours worked (between 1997 and 1991) and age in 1991.

Figure 2: Proportion Working During Previous Year by Age in 1991

Men	**Women**



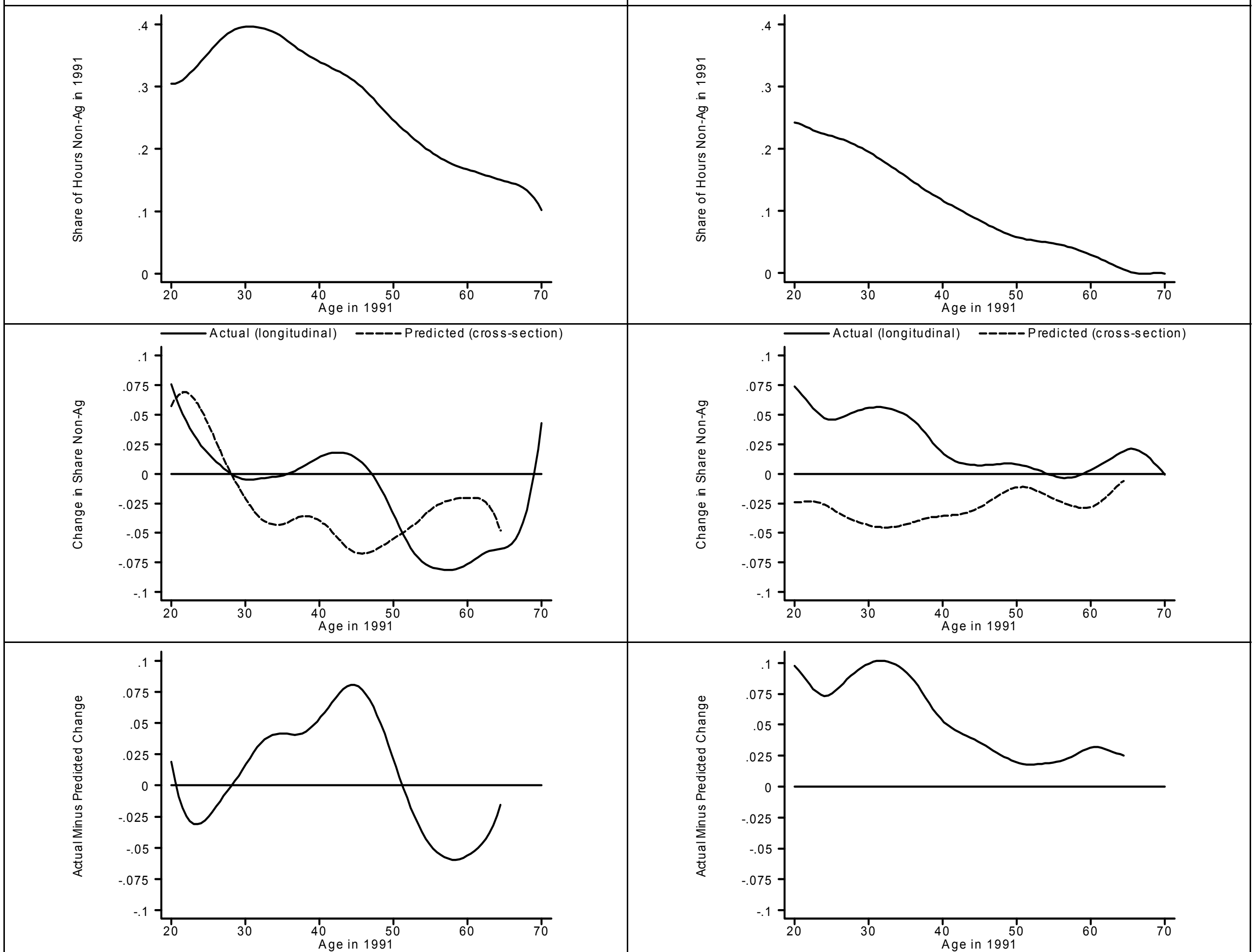
Source: CHNS, 1991,1993,1997

Notes:

1. Each figure represents a non-parametric simple regression of the dependent variable ("y-axis") against the independent variable ("x-axis");
2. The top panels show the 1991 cross-section relationship between participation (positive hours worked) and age, while the bottom panels follow the panel households between 1991 and 1997, plotting the changes in participation (between 1997 and 1991) and age in 1991.

Figure 3: Proportion of Work Hours in Non-Agricultural Employment (CONDITIONAL on working)

Men	**Women**



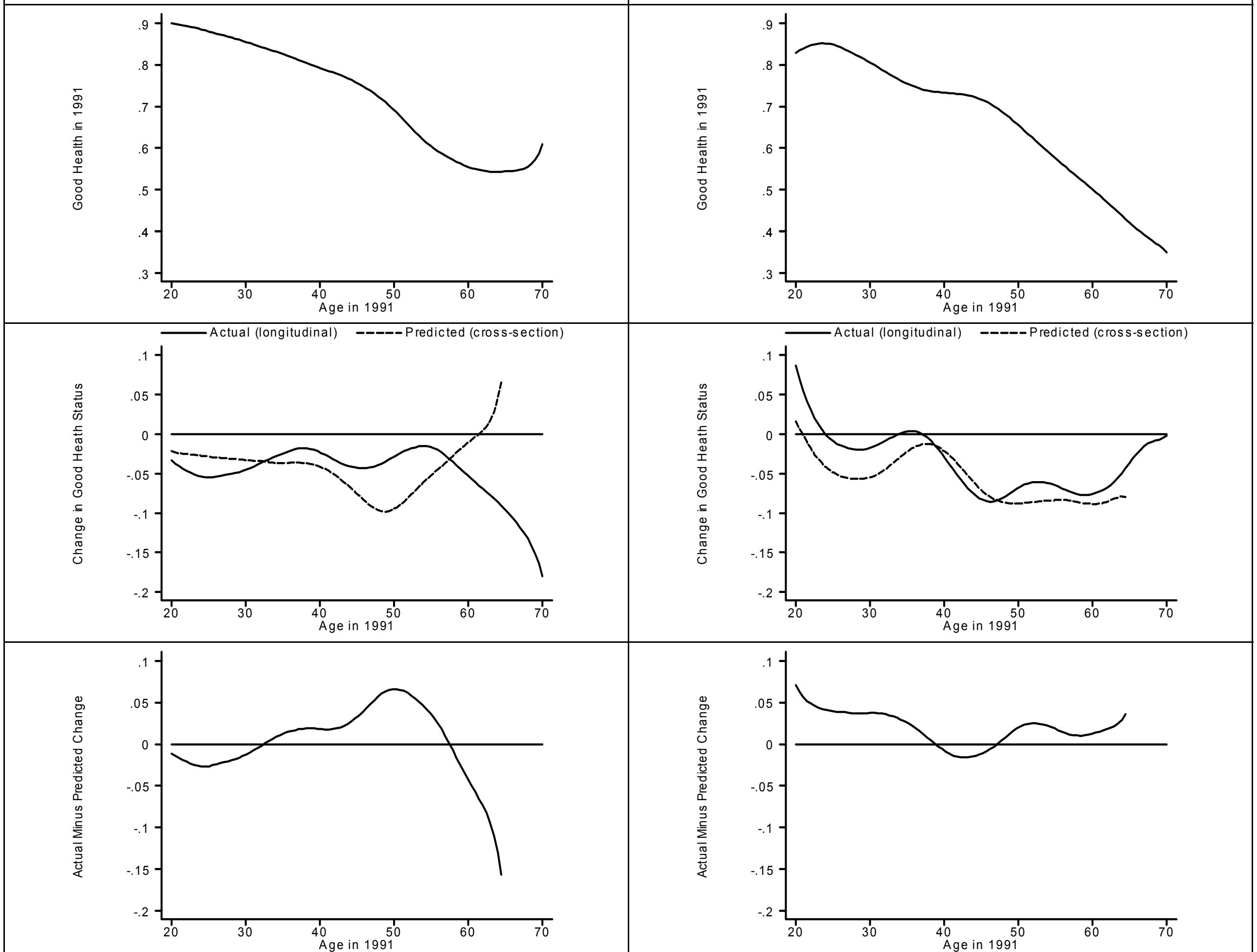
Source: CHNS, 1991,1993,1997

Notes:

1. Each figure represents a non-parametric simple regression of the dependent variable ("y-axis") against the independent variable ("x-axis");
2. The top panels show the 1991 cross-section relationship between the share of work hours in non-agricultural employment (off-farm, or family run businesses, conditional on positive hours worked) and age, while the bottom panels follow the panel households between 1991 and 1997, plotting the changes in proportion of time spent in non-agricultural pursuits (between 1997 and 1991) and age in 1991.

Figure 4: Self-Reported Health Status by Age in 1991

Men	**Women**



Source: CHNS, 1991,1993,1997

Notes:

1. Each figure represents a non-parametric simple regression of the dependent variable ("y-axis") against the independent variable ("x-axis");
2. The top panels show the 1991 cross-section relationship between being in "good health" (Self-reported health status in top two categories, i.e., "H12") and age, while the bottom panels follow the panel households between 1991 and 1997, plotting the changes in proportion in good health (between 1997 and 1991) and age in 1991.

Table 1
Descriptive Statistics for Sample Individuals, 1991

	All Men		Men 50+		All Women		Women 50+	
Labor Supply								
Positive Weeks Worked	0.92		0.82		0.93		0.82	
Annual Hours Worked	1962		1686		2036		1565	
Wage Work (and %)	495	(25.2%)	256	(15.2%)	233	(11.4%)	50	(3.2%)
Gardening (and %)	129	(6.6%)	160	(9.5%)	171	(8.4%)	171	(10.9%)
Farming (and %)	1037	(52.9%)	1031	(61.2%)	1118	(54.9%)	863	(55.1%)
Animal Husbandry (and %)	121	(6.2%)	142	(8.4%)	460	(22.6%)	444	(28.4%)
Fishing (and %)	10	(0.5%)	4	(0.2%)	2	(0.1%)	1	(0.1%)
Family Business (and %)	168	(8.6%)	94	(5.6%)	53	(2.6%)	36	(2.3%)
Health								
Good Health (H12)	0.74		0.58		0.72		0.53	
BMI	21.15		20.91		21.50		20.96	
Low BMI	0.20		0.26		0.20		0.30	
High BMI	0.11		0.13		0.20		0.17	
Index of Physical Functions	-2.27		-2.40		-2.29		-2.43	
Subsequent Death	0.07		0.17		0.03		0.06	
Demographic Characteristics								
Age	43.6		59.3		41.6		58.6	
Education	5.9		3.5		3.5		0.8	
Household Size	4.6		4.4		4.6		4.3	
Sample Size	1253		375		1266		296	

Notes:

1. The full sample is defined as all men or women over the age of 20 who were in the 1991-1997 panel, unless they "left the sample" because of death. Furthermore, the sample is restricted to those individuals with observations for all variables, including spouse's health status. This effectively restricts the sample to married individuals with a living spouse. Men and Women 50+ is the subsample of individuals 50 years and older.
2. The Labor supply variables are: (1) an indicator of whether the person worked positive weeks in the previous year; (2) hours worked in the previous year, including zeroes; (3) Hours spent in various types of work, (with the percentage of total hours in parentheses).
3. The health measures are: (1) H12 (self-reported health in the top two categories); (2) BMI; (3) Low BMI (BMI less than the 20^{th} percentile); (4) High BMI (BMI greater than the 80^{th} percentile); (5) An index of physical infirmities (described in the appendix); and (6) An indicator of whether the person died between 1991 and 1997.

Table 2
The Information Content of Health Measures
(absolute *t*-values in parentheses, * indicates statistical significance at the 5% level)

	Men		Women	
	Full Sample	**Older Sample**	**Full Sample**	**Older Sample**
Subsequent Death:				
H12	-0.035*	-0.062*	-0.031*	-0.045*
	(2.3)	(2.6)	(3.0)	(2.6)
Low BMI	-0.024	-0.042	0.017	0.026
	(1.4)	(1.5)	(1.4)	(1.3)
High BMI	-0.019	-0.024	0.000	-0.014
	(0.9)	(0.7)	(0.0)	(0.7)
Index of Physical Functions	-0.560*	-0.588*	-0.071	-0.041
	(3.9)	(3.0)	(0.8)	(0.3)
Hours Worked:				
Subsequent Death	-320.5*	-363.5*	-729.1*	-839.9*
	(2.2)	(2.2)	(3.1)	(3.3)
H12	133.8	223.9*	-122.5	-65.7
	(1.7)	(2.2)	(1.4)	(0.6)
Low BMI	-15.9	-133.5	-90.5	42.2
	(0.2)	(1.1)	(0.9)	(0.3)
High BMI	-118.2	-98.1	-67.9	16.6
	(1.1)	(0.7)	(0.7)	(0.1)
Index of Physical Functions	490.7	570.6	1009.5	1539.2
	(0.7)	(0.7)	(1.4)	(1.8)
Sample Size	1226	716	1237	637

Notes:
1. In the first panel, the reported coefficients are from regressions of an indicator of whether an individual died between 1991 and 1997, as a function of his/her health in 1991. The regression includes other covariates: age-group dummies (defined in the text, and in Table 3), years of education, and province dummies.
2. The second panel shows cross-section estimates of individual labor supply (hours worked) in 1991 as a function of health status in 1991, including a variable indicating whether the person subsequently died (by the 1997 survey). The regression includes the standard covariates (age dummies, education, and province dummies).
3. The regressions are estimated separately for men and women, for the full sample, and for the sample 40 and older.
4. The health indicators are described in the text, and in Table 3 (H12 is the indicator of self-reported good health; Low and High BMI; and an index of physical functions (where higher numbers mean better health).

Table 3
Labor Supply- and Health-Age Profiles
Men and Women
(* indicates significance at the 5% level)

	Age 50 to 60		Age 60 to 70		Hausman Tests		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	RE (*t*-value)	FE (*t*-value)	RE (*t*-value)	FE (*t*-value)	50-60 (*t*-values)	60-70 (*t*-values)	All (*p*-value)
Men:							
Hours	-356.2* (3.7)	79.0 (0.4)	-542.3* (3.6)	-453.8 (1.9)	-435.3* (2.6)	-88.4 (0.5)	30.2* (0.011)
Participation	-0.144* (6.3)	-0.035 (0.8)	-0.301* (8.4)	-0.261* (4.7)	-0.109* (2.8)	-0.040 (0.9)	38.2* (0.001)
H12	-0.097* (2.8)	0.003 (0.0)	-0.073 (1.3)	-0.082 (0.9)	-0.100 (1.5)	0.009 (0.1)	27.9* (0.023)
Low BMI	0.093* (3.2)	0.026 (0.5)	0.036 (0.8)	0.045 (0.7)	0.067 (1.6)	-0.010 (0.2)	28.1* (0.021)
High BMI	-0.008 (0.3)	0.004 (0.1)	0.080* (2.0)	0.070 (1.3)	-0.012 (0.3)	0.009 (0.2)	8.1 (0.921)
Women:							
Hours	-431.0* (4.1)	-341.7 (1.7)	-382.9* (2.1)	97.6 (0.3)	-89.3 (0.5)	-480.5 (2.0)	11.3 (0.734)
Participation	-0.123* (5.2)	-0.055 (1.2)	-0.246* (5.8)	-0.154* (2.3)	-0.068 (1.7)	-0.092 (1.7)	17.6 (0.283)
H12	-0.083* (2.1)	0.045 (0.5)	-0.101 (1.4)	-0.146 (1.2)	-0.127 (1.8)	0.045 (0.5)	14.6 (0.483)
Low BMI	0.012 (0.4)	-0.046 (0.9)	0.050 (0.9)	0.030 (0.4)	0.058 (1.3)	0.020 (0.4)	27.4* (0.025)
High BMI	0.015 (0.5)	0.083 (1.6)	-0.092 (1.7)	-0.044 (0.6)	-0.067 (1.6)	-0.049 (0.9)	11.5 (0.716)

Notes:

1. The estimated age profile is based on the difference in age coefficients from a regression of the dependent variable on covariates: age-group dummies (20-24, 25-29,…, 80+); year dummies for 1993, 1997; years of education; and province dummies. The Age 50 to 60 "profile" is the difference between the age 60-64 and age 50-54 coefficients, while the Age 60 to 70 "profile" is the difference between the age 70-74 and age 60-64 coefficients. *t*-values are reported for the hypothesis that the difference is zero.
2. The dependent variables for the labor supply measures are: Hours (hours worked in the previous year, including zero); Participation (whether the individual worked at all the previous year); H12 (self-reported health in the top two categories); Low BMI (BMI less than the 20^{th} percentile); and High BMI (BMI greater than the 80^{th} percentile).
3. The regressions are estimated over the pooled sample (1991, 1993, and 1997) separately for men (in the top panel) and women (in the bottom panel) 20 years and older. Sample size is 3600 for men, and 3602 for women.
4. "RE" refers to the random effects specification, while "FE" refers to the (individual) fixed effects specification.
5. The Hausman Test columns ((5), (6), (7)) report the results of the Hausman tests of random versus fixed effects. Column (5) reports the test of the difference in estimated age effects (RE versus FE) for aging between 50 and 60, while column (6) reports the corresponding test for 60 to 70. Column (7) provides the conventional Hausman test for all of the coefficients.

Table 4
Structural Models: The Effect of Health on Labor Supply
Men 20 and Older
(absolute *t*-values in parentheses, * indicates statistical significance at the 5% level)

	Random Effects		Fixed Effects	
	OLS	**IV**	**OLS**	**IV**
Hours:				
H12	161.8*	1076.1*	137.9	2539.8*
	(2.7)	(3.0)	(1.8)	(2.6)
Wife's H12	-145.3*	-458.2	-104.2	-1301.6
	(2.6)	(1.2)	(1.4)	(1.5)
Low BMI	-57.6	44.5	-182.7*	-162.9
	(1.1)	(0.6)	(2.2)	(0.9)
High BMI	-64.7	-147.1	-11.3	-29.5
	(1.1)	(1.8)	(0.1)	(0.2)
Participation:				
H12	0.043*	0.112	0.046*	0.133
	(3.1)	(1.4)	(2.6)	(0.7)
Wife's H12	-0.049*	-0.169	-0.040*	-0.299
	(3.6)	(1.9)	(2.3)	(1.7)
Low BMI	-0.007	0.017	-0.049*	-0.024
	(0.5)	(1.0)	(2.5)	(0.7)
High BMI	-0.048*	-0.052*	-0.018	-0.027
	(3.3)	(2.8)	(0.8)	(0.7)

Notes:

1. The estimated coefficients are the coefficients from a regression of labor supply (hours or participation) on health variables (H12 = good health; wife's H12; and own Low and High BMI indicators), plus covariates (age group dummies (the same as table 2), years of education, year and province dummies. Absolute *t*-values for the coefficients are shown in parentheses.
2. "OLS" is estimated on the full pooled sample of men 20 and older (1991,1993,1997), and is estimated by Random and Fixed Effects. The sample size is 3600.
3. "IV" is 2SLS estimation for the two available years (1991 and 1993) with an index of physical "infirmities" for the individual and spouse as instruments for individual and spouse H12. The sample size is 2257. The IV specification is also estimated by Random and Fixed Effects.
4. The *t*-value for the difference between the OLS and IV own H12 coefficients (i.e., the Hausman Tests) are (1) For RE Hours, 2.59; (2) For FE Hours, 2.47; (3) For RE Participation, 0.88; (4) For FE Participation, 0.46.

Table 5
Structural Models: The Effect of Health on Labor Supply
Women 20 and Older
(absolute *t*-values in parentheses)

	Random Effects		Fixed Effects	
	OLS	**IV**	**OLS**	**IV**
Hours:				
H12	19.6	1476.4*	-18.0	1049.7
	(0.3)	(3.2)	(0.3)	(1.1)
Husband's H12	-87.3	-996.4*	23.4	-2317.4
	(1.5)	(2.8)	(0.3)	(1.9)
Low BMI	12.7	48.1	142.8	226.1
	(0.2)	(0.6)	(1.7)	(0.9)
High BMI	-35.2	11.6	-0.7	187.9
	(0.7)	(0.2)	(0.0)	(0.8)
Participation:				
H12	0.007	0.091	0.008	-0.092
	(0.6)	(1.0)	(0.5)	(0.5)
Husband's H12	-0.026	-0.056	-0.018	-0.345
	(1.9)	(0.8)	(1.1)	(1.4)
Low BMI	0.018	0.022	0.011	0.081
	(1.5)	(1.4)	(0.6)	(1.7)
High BMI	-0.013	-0.017	0.028	0.081
	(1.0)	(1.2)	(1.5)	(1.7)

Notes:

1. The estimated coefficients are the coefficients from a regression of labor supply (hours or participation) on health variables (H12 = good health; husband's H12; and own Low and High BMI indicators), plus covariates (age group dummies (the same as table 4), years of education, year and province dummies. Absolute *t*-values for the coefficients are shown in parentheses.
2. "OLS" is estimated on the full pooled sample of women 20 and older (1991,1993,1997), and is estimated by Random and Fixed Effects. The sample size is 3602.
3. "IV" is 2SLS estimation for the two available years (1991 and 1993) with an index of physical "infirmities" for the individual and spouse as instruments for individual and spouse H12. The sample size is 2137. The IV specification is also estimated by Random and Fixed Effects.
4. The *t*-value for the difference between the OLS and IV own H12 coefficients (i.e., the Hausman Tests) are (1) For RE Hours, 3.19; (2) For FE Hours, 0.93; (3) For RE Participation, 0.88; (4) For FE Participation, 0.54. For the effect of husband's H12 (on hours), the RE Hausman test is 2.59, and for FE it is 1.92.

Table 6
The Estimated Effect of Health on Labor Supply
Summary Results

	Age Change			
	50 to 60		**60 to 70**	
	RE	**FE**	**RE**	**FE**
Men				
Change in hours:	**-356.2**	**79.0**	**-542.3**	**-453.8**
Explained by:				
H12 (OLS)	-15.7	0.5	-11.9	-11.3
H12, BMI (OLS)	-20.5	-4.4	-19.1	-20.4
H12 (IV)	-104.3	8.9	-79.0	-208.2
H12, BMI (IV)	-99.0	4.5	-89.2	-217.7
Change in participation:	**-0.144**	**-0.035**	**-0.301**	**-0.261**
Explained by:				
H12 (OLS)	-0.004	0.000	-0.003	-0.004
H12, BMI (OLS)	-0.004	-0.001	-0.007	-0.007
H12 (IV)	-0.011	0.000	-0.008	-0.011
H12, BMI (IV)	-0.009	0.000	-0.012	-0.014
Women				
Change in hours:	**-431.0**	**-341.7**	**-382.9**	**97.6**
Explained by:				
H12 (OLS)	-1.6	-0.8	-2.0	2.6
H12, BMI (OLS)	-2.0	-7.5	1.9	6.9
H12 (IV)	-121.9	47.0	-148.6	-153.3
H12, BMI (IV)	-121.2	52.1	-147.3	-154.8
Change in participation:	**-0.123**	**-0.055**	**-0.246**	**-0.154**
Explained by:				
H12 (OLS)	-0.001	0.000	-0.001	-0.001
H12, BMI (OLS)	-0.001	0.002	0.001	-0.002
H12 (IV)	-0.008	-0.004	-0.009	0.013
H12, BMI (IV)	-0.008	-0.001	-0.007	0.012

Notes:
1. The estimated effect of health on labor supply is the predicted impact of the change in health (H12, or H12 and BMI), reported in Table 3, multiplied by the estimated "structural" effect of health on labor supply (from Tables 4 and 5).
2. OLS refers to predictions based on OLS coefficients, while IV refers to the 2SLS-based coefficients. The benchmark is the estimated labor supply-age profile from Table 3.

Table 7
The Interaction of Wealth and Labor Supply
OLS Estimates
(absolute *t*-values in parentheses, * indicates statistical significance at the 5% level)

	Men				Women			
	Hours		Participation		Hours		Participation	
	RE	FE	RE	FE	RE	FE	RE	FE
H12	921.3	1767.2*	-0.110	0.201	-1078.6	-1713.7*	-0.044	-0.196
	(1.6)	(2.2)	(0.8)	(1.2)	(1.9)	(2.4)	(0.4)	(1.3)
Spouse's H12	-599.3	-610.1	0.184	0.015	1561.4*	2807.9*	0.164	0.352*
	(1.0)	(0.8)	(1.4)	(0.1)	(2.6)	(3.7)	(1.3)	(2.2)
Wealth×H12	-88.4	-200.3	0.022	-0.019	157.1*	242.2*	0.006	0.026
	(1.1)	(1.9)	(1.3)	(0.8)	(2.1)	(2.6)	(0.4)	(1.3)
Wealth× SH12	44.8	51.5	-0.032	-0.009	-221.5*	-387.8*	-0.024	-0.049*
	(0.6)	(0.5)	(1.9)	(0.4)	(2.8)	(3.9)	(1.4)	(2.3)
Wealth	147.9	257.2*	0.008	0.038	169.5*	318.3*	0.019	0.029
	(1.8)	(2.0)	(0.4)	(1.4)	(2.1)	(2.9)	(1.1)	(1.3)
Wealth×A2024	267.3	506.2	-0.029	-0.017	310.7	607.9	0.076	0.077
	(1.2)	(1.3)	(0.6)	(0.2)	(1.5)	(1.9)	(1.7)	(1.2)
Wealth×A2529	-19.0	111.3	0.022	0.054	-110.5	-9.0	0.004	0.025
	(0.2)	(0.6)	(0.9)	(1.3)	(1.0)	(0.1)	(0.2)	(0.8)
Wealth×A3034	-70.6	-127.0	-0.014	-0.034	-144.1	-180.6	-0.018	-0.024
	(0.7)	(0.9)	(0.6)	(1.1)	(1.6)	(1.5)	(1.0)	(1.0)
Wealth×A3539	-44.8	-157.6	0.002	-0.015	-81.2	-119.5	-0.013	-0.002
	(0.5)	(1.3)	(0.1)	(0.6)	(1.0)	(1.2)	(0.7)	(0.1)
Wealth×A4549	35.6	-11.2	-0.002	-0.007	-72.7	2.8	-0.011	-0.013
	(0.4)	(0.1)	(0.1)	(0.3)	(0.9)	(0.0)	(0.6)	(0.6)
Wealth×A5054	7.5	-146.1	-0.017	-0.041	-188.3	-256.7	-0.051*	-0.060*
	(0.1)	(1.1)	(0.8)	(1.4)	(1.9)	(1.9)	(2.4)	(2.2)
Wealth×A5559	-197.0	-201.4	-0.017	0.002	-198.1	-283.3	-0.024	-0.015
	(1.8)	(1.3)	(0.7)	(0.1)	(1.7)	(1.8)	(1.0)	(0.5)
Wealth×A6064	-239.2	-321.6	-0.026	-0.020	-245.4	-308.5	-0.039	-0.038
	(1.9)	(1.7)	(0.9)	(0.5)	(1.8)	(1.6)	(1.4)	(1.0)
Wealth×A6569	-319.3*	-449.4	-0.108*	0.015	-300.7*	-471.7*	-0.055	-0.098*
	(2.3)	(1.9)	(3.4)	(0.3)	(2.0)	(2.0)	(1.7)	(2.0)
Wealth×A7074	-352.2	-419.8	-0.117*	0.033	-159.0	-415.7	-0.103*	-0.204*
	(1.8)	(1.4)	(2.6)	(0.5)	(0.8)	(1.3)	(2.5)	(3.1)
Wealth×A7579	-268.9	-576.5	-0.172*	-0.447	-258.1	-307.7	-0.192*	-0.241*
	(1.1)	(0.5)	(3.1)	(1.8)	(0.9)	(0.7)	(3.2)	(2.5)
Wealth×A80	-333.2	567.4	-0.212*	-0.856*	-265.3	-495.3	-0.300	-0.732*
	(0.9)	(0.5)	(2.4)	(3.7)	(0.2)	(0.4)	(1.3)	(2.6)

Notes:
1. The coefficients are from a regression of labor supply (hours and participation) on the base covariates (the same as Tables 3 and 5), with log per capita wealth included, and interacted with the health and age-group dummies. The omitted age category is A4044.
2. The regressions are estimated for men 20 years and older (sample size = 2183) and women 20 years and older (sample size = 2141)
3. Models are estimated by "OLS" (i.e., not instrumental variables) by Random Effects (RE) and Fixed Effects (FE).

Table 8
The Composition of Household Per Capita Income
By Age, Gender, and Year

	1991			1997		
Age Group:	**20-39**	**40-59**	**60+**	**20-39**	**40-59**	**60+**
Men:						
Farm (crop) income	239	301	287	328	353	254
Income from home gardens	159	157	167	145	141	104
Livestock income	51	51	40	62	71	78
Wage income	171	187	125	363	432	169
Income from family businesses	160	130	82	319	197	135
Other income	117	118	211	159	174	327
Total Per Capita Income	**898**	**943**	**911**	**1377**	**1368**	**1066**
Age Group:	**20-39**	**40-59**	**60+**	**20-39**	**40-59**	**60+**
Women:						
Farm (crop) income	241	329	226	335	349	220
Income from home gardens	144	162	170	134	115	123
Livestock income	59	53	31	74	73	73
Wage income	192	202	124	411	413	176
Income from family businesses	145	96	132	308	214	131
Other income	106	124	176	142	184	364
Total Per Capita Income	**887**	**967**	**859**	**1404**	**1347**	**1086**

Notes:

1. This table shows mean household per capita income by source, where household income is assigned equally to household members. This reported numbers are then compared across individuals in the various age and sex groups.
2. All figures are denominated in constant 1991 RMB, employing province-level CPI’s as deflators.

Table 9
Log Per Capita Income and Age
(* indicates statistical significance at the 5% level)

	Men			Women		
Reduced Form Aging Profiles (t-values in parentheses):						
	RE	**FE**	**Hausman**	**RE**	**FE**	**Hausman**
Age 50 to 60	0.020	0.068	-0.048	-0.117	-0.377*	0.260
	(0.3)	(0.5)	(0.4)	(1.6)	(2.7)	(2.2)
Age 60 to 70	-0.193	-0.457*	0.264	-0.131	-0.572*	0.441
	(1.8)	(2.8)	(2.1)	(1.0)	(2.8)	(2.8)
Hausman Test	37.86*			25.41*		
(RE vs. FE)	(0.001)			(0.045)		

Notes:
1. The first panel reports the reduced form aging profiles (analogous to Tables 2 and 4) for log per capita household income. See the notes to Tables 2 and 4 for details. The Hausman Test concerns the hypothesis that the random and fixed effects estimators are the same.

Appendix Table A1
Sampling Patterns (Attrition) for CHNS (Rural)

	Communities		Households		Individuals	
	Number	Percentage	Number	Percentage	Number	Percentage
In 1991 Only			91	3.0	1,201	9.4
In 1993 Only			12	0.4	309	2.4
In 1997 Only	17	11.9	577	19.0	2,071	16.2
In 1991 & 1993	18	12.6	411	13.5	2,006	15.7
In 1993 & 1997			36	1.2	504	3.9
In 1991 & 1997			55	1.8	768	6.0
In 1991, 1992, & 1993	108	75.5	1,863	61.2	5,926	46.4
Total	143	100.0	3,045	100.0	12,785	100.0

Notes:

1. The table provides in formation on how many individuals, households, and communities appear in the 1991, 1993, and 1997 CHNS for each year and combination of years.
2. The percentages are column percentages for each category

Appendix Table A2
First Stage Regressions
(absolute t-values in parentheses, * indicates statistical significance at the 5% level)

Men

	Full Sample				Older Sample (40 and Older)			
	Random Effects		Fixed Effects		Random Effects		Fixed Effects	
Instrumented Variable:	**H12**	**SH12**	**H12**	**SH12**	**H12**	**SH12**	**H12**	**SH12**
Physical Functions Index	1.560*	0.152	0.916*	-0.471	1.634*	0.220	0.876*	-0.557
	(8.3)	(0.8)	(2.8)	(1.3)	(7.8)	(1.0)	(2.3)	(1.4)
Wife's Physical Functions Index	0.223	1.423*	0.391	1.219*	0.234	1.556*	0.674	1.569*
	(1.2)	(7.4)	(1.2)	(3.6)	(1.1)	(7.1)	(1.8)	(3.9)
Low BMI	-0.009	0.060*	0.049	0.103*	-0.013	0.070*	0.061	0.116
	(0.4)	(2.4)	(1.0)	(2.0)	(0.4)	(2.1)	(0.9)	(1.6)
High BMI	0.027	0.004	0.036	-0.022	0.044	0.013	-0.025	-0.095
	(1.0)	(0.1)	(0.6)	(0.3)	(1.1)	(0.3)	(0.3)	(0.9)
Chi-squared Test	80.9*	61.3*	5.8*	6.4*	70.6*	58.6*	5.9*	7.5*
(p-value)	(0.000)	(0.000)	(0.003)	(0.002)	(0.000)	(0.000)	(0.003)	(0.001)
Sample Size	2257	2257	2257	2257	1395	1395	1395	1395

Women

	Full Sample				Older Sample (40 and Older)			
	Random Effects		Fixed Effects		Random Effects		Fixed Effects	
Instrumented Variable:	**H12**	**SH12**	**H12**	**SH12**	**H12**	**SH12**	**H12**	**SH12**
Physical Functions Index	1.370*	0.233	1.220*	0.293	1.426*	0.241	1.511*	0.474
	(6.9)	(1.2)	(3.4)	(0.9)	(6.3)	(1.1)	(3.6)	(1.2)
Husband's Physical Functions Index	0.113	1.683*	-0.527	0.791*	0.170	1.736*	-0.605	0.793*
	(0.6)	(9.2)	(1.5)	(2.4)	(0.8)	(8.4)	(1.5)	(2.1)
Low BMI	-0.051*	-0.010	0.149*	0.096	-0.051	-0.024	0.204*	0.094
	(2.0)	(0.4)	(2.8)	(1.9)	(1.4)	(0.7)	(2.6)	(1.3)
High BMI	-0.008	0.005	0.119*	0.105	0.014	0.029	0.079	0.096
	(0.3)	(0.2)	(2.0)	(1.9)	(0.4)	(0.8)	(0.9)	(1.2)
Chi-squared Test	52.8*	98.5*	6.0*	4.0*	45.5*	80.7*	6.6*	3.7*
(p-value)	(0.000)	(0.000)	(0.003)	(0.018)	(0.000)	(0.000)	(0.002)	(0.026)
Sample Size	2137	2137	2137	2137	1190	1190	1190	1190

Notes:

1. The reported coefficients are from the first stage equations corresponding to the "structural" labor supply equations summarized in Tables 3, 5, 3A and 5A.
2. The dependent variables are the self reported health measures: own good health (H12) and spouse's good health (SH12). The explanatory variables are the full set of covariates (age group dummies, years of education, year dummy, and province dummies), plus the reported health coefficients.
3. The excluded (identifying) instruments are the own and spouse's index of physical functions (problems). The Chi-square test (and p-value) is of the null hypothesis that these two variables can be excluded from the first-stage equation. The hypothesis is rejected in each case.

Appendix Table A3
Labor Supply- and Health-Age Profiles
Men and Women
(* indicates significance at the 5% level)

	Age 50 to 60		**Age 60 to 70**		**Hausman Tests**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
	RE (*t*-value)	**FE (*t*-value)**	**RE (*t*-value)**	**FE (*t*-value)**	**50-60 (*t*-values)**	**60-70 (*t*-values)**	**All (*p*-value)**
Men:							
Hours	-351.1* (3.6)	261.7 (1.2)	-532.0* (3.5)	-285.0 (1.1)	-612.8* (3.2)	-247.0 (1.2)	32.6* (0.001)
Participation	-0.142* (5.8)	-0.022 (0.4)	-0.301* (7.9)	-0.248* (4.1)	-0.119* (2.7)	-0.053 (1.1)	36.8* (0.000)
H12	-0.094* (2.5)	-0.036 (0.4)	-0.078 (1.3)	-0.128 (1.2)	-0.058 (0.8)	0.050 (0.6)	17.4 (0.096)
Low BMI	0.102* (3.5)	0.043 (0.8)	0.010 (0.2)	0.034 (0.5)	0.059 (1.3)	-0.025 (0.5)	26.1* (0.006)
High BMI	0.007 (0.3)	0.036 (0.8)	0.062 (1.7)	0.067 (1.3)	-0.029 (0.8)	-0.005 (0.1)	3.7 (0.978)
Women:							
Hours	-422.6* (4.0)	-119.2 (0.5)	-394.3* (2.1)	317.4 (1.0)	-303.4 (1.4)	-711.6* (2.6)	11.6 (0.398)
Participation	-0.116* (4.5)	-0.007 (0.1)	-0.244* (5.4)	-0.102 (1.3)	-0.109* (2.2)	-0.142* (2.2)	21.7* (0.027)
H12	-0.089* (2.2)	0.051 (0.5)	-0.096 (1.3)	-0.140 (1.0)	-0.140 (1.6)	0.044 (0.4)	16.9 (0.111)
Low BMI	0.024 (0.8)	-0.030 (0.5)	0.019 (0.3)	-0.020 (0.2)	0.054 (1.0)	0.039 (0.6)	12.5 (0.330)
High BMI	0.028 (0.9)	0.129* (2.3)	-0.068 (1.3)	0.023 (0.3)	-0.100* (2.1)	-0.091 (1.6)	11.0 (0.445)

Notes:

1. The estimated age profile is based on the difference in age coefficients from a regression of the dependent variable on covariates: age-group dummies (20-24, 25-29,…, 80+); year dummies for 1993, 1997; years of education; and province dummies. The Age 50 to 60 "profile" is the difference between the age 60-64 and age 50-54 coefficients, while the Age 60 to 70 "profile" is the difference between the age 70-74 and age 60-64 coefficients. *t*-values are reported for the hypothesis that the difference is zero.
2. The dependent variables for the labor supply measures are: Hours (hours worked in the previous year, including zero); Participation (whether the individual worked at all the previous year); H12 (self-reported health in the top two categories); Low BMI (BMI less than the 20^{th} percentile); and High BMI (BMI greater than the 80^{th} percentile).
3. The regressions are estimated over the pooled sample (1991, 1993, and 1997) separately for men (in the top panel) and women (in the bottom panel) 40 years and older. Sample size is 2359 for men, and 2159 for women.
4. "RE" refers to the random effects specification, while "FE" refers to the (individual) fixed effects specification.
5. The Hausman Test columns ((5), (6), (7)) report the results of the Hausman tests of random versus fixed effects. Column (5) reports the test of the difference in estimated age effects (RE versus FE) for aging between 50 and 60, while column (6) reports the corresponding test for 60 to 70. Column (7) provides the conventional Hausman test for all of the coefficients.

Appendix Table A4
Structural Models: The Effect of Health on Labour Supply
Men 40 and Older
(absolute *t*-values in parentheses, * indicates statistical significance at the 5% level)

	Random Effects		**Fixed Effects**	
	OLS	**IV**	**OLS**	**IV**
Hours:				
H12	211.1*	999.4*	194.3*	2999.1*
	(3.0)	(2.7)	(2.1)	(2.8)
Wife's H12	-154.5*	-285.7	-76.7	-1419.3
	(2.3)	(0.7)	(0.9)	(1.6)
Low BMI	-106.7	-5.8	-285.3*	-234.0
	(1.6)	(0.1)	(2.5)	(1.0)
High BMI	-80.3	-148.5	54.0	147.4
	(1.0)	(1.3)	(0.4)	(0.4)
Participation:				
H12	0.049*	0.109	0.050*	0.158
	(2.9)	(1.2)	(2.3)	(0.8)
Wife's H12	-0.051*	-0.139	-0.034	-0.306
	(3.1)	(1.5)	(1.6)	(1.8)
Low BMI	-0.017	0.004	-0.069*	-0.034
	(1.0)	(0.2)	(2.5)	(0.7)
High BMI	-0.071*	-0.069*	-0.031	-0.032
	(3.5)	(2.6)	(0.9)	(0.5)

Notes:

1. The estimated coefficients are the coefficients from a regression of labour supply (hours or participation) on health variables (H12 = good health; wife's H12; and own Low and High BMI indicators), plus covariates (age group dummies (the same as table 2A), years of education, year and province dummies. Absolute *t*-values for the coefficients are shown in parentheses.
2. "OLS" is estimated on the full pooled sample of men 40 and older (1991,1993,1997), and is estimated by Random and Fixed Effects. The sample size is 2359.
3. "IV" is 2SLS estimation for the two available years (1991 and 1993) with an index of physical "infirmities" for the individual and spouse as instruments for individual and spouse H12. The sample size is 1395. The IV specification is also estimated by Random and Fixed Effects.
4. The *t*-value for the difference between the OLS and IV own H12 coefficients (i.e., the Hausman Tests) are (1) For RE Hours, 2.17; (2) For FE Hours, 2.63; (3) For RE Participation, 0.67; (4) For FE Participation, 0.55.

Appendix Table A5
Structural Models: The Effect of Health on Labor Supply
Women 40 and Older
(absolute *t*-values in parentheses, * indicates statistical significance at the 5% level)

	Random Effects		Fixed Effects	
	OLS	**IV**	**OLS**	**IV**
Hours:				
H12	120.5	1698.5*	61.2	1682.1
	(1.7)	(3.5)	(0.7)	(1.7)
Husband's H12	-123.5	-1134.5*	21.5	-2625.1
	(1.7)	(3.0)	(0.2)	(1.9)
Low BMI	141.4*	287.3*	253.7*	482.8
	(2.1)	(2.6)	(2.2)	(1.4)
High BMI	-67.6	-17.6	97.4	142.7
	(1.0)	(0.2)	(0.8)	(0.5)
Participation:				
H12	0.016	0.105	0.016	-0.042
	(1.0)	(1.0)	(0.8)	(0.2)
Husband's H12	-0.022	-0.036	-0.021	-0.287
	(1.3)	(0.5)	(0.9)	(1.2)
Low BMI	0.021	0.047*	0.003	0.091
	(1.2)	(2.0)	(0.1)	(1.5)
High BMI	-0.016	-0.002	0.041	0.096
	(0.9)	(0.1)	(1.4)	(1.7)

Notes:

1. The estimated coefficients are the coefficients from a regression of labour supply (hours or participation) on health variables (H12 = good health; husband's H12; and own Low and High BMI indicators), plus covariates (age group dummies (the same as table 4A), years of education, year and province dummies. Absolute *t*-values for the coefficients are shown in parentheses.
2. "OLS" is estimated on the full pooled sample of women 40 and older (1991,1993,1997), and is estimated by Random and Fixed Effects. The sample size is 2159.
3. "IV" is 2SLS estimation for the two available years (1991 and 1993) with an index of physical "infirmities" for the individual and spouse as instruments for individual and spouse H12. The sample size is 1190. The IV specification is also estimated by Random and Fixed Effects.
4. The *t*-value for the difference between the OLS and IV own H12 coefficients (i.e., the Hausman Tests) are (1) For RE Hours, 3.29; (2) For FE Hours, 1.64; (3) For RE Participation, 0.86; (4) For FE Participation, 0.28. For the effect of husband's H12 (on hours), the RE Hausman test is 2.72, and for FE it is 1.92.

Appendix Table A6
The Estimated Effect of Health on Labor Supply
Men and Women 40 and Older
Summary Results

	Age Change			
	50 to 60		**60 to 70**	
	RE	**FE**	**RE**	**FE**
Men				
Change in hours:	**-351.1**	**261.7**	**-532.0**	**-285.0**
Explained by:				
H12 (OLS)	-19.9	-7.1	-16.4	-24.8
H12, BMI (OLS)	-31.4	-17.4	-22.4	-31.0
H12 (IV)	-94.4	-108.9	-77.7	-383.4
H12, BMI (IV)	-96.0	-113.8	-86.9	-381.6
Change in participation:	**-0.142**	**-0.022**	**-0.301**	**-0.248**
Explained by:				
H12 (OLS)	-0.005	-0.002	-0.004	-0.006
H12, BMI (OLS)	-0.007	-0.006	-0.008	-0.011
H12 (IV)	-0.010	-0.006	-0.008	-0.020
H12, BMI (IV)	-0.010	-0.008	-0.013	-0.024
Women				
Change in hours:	**-422.6**	**-119.2**	**-394.3**	**317.4**
Explained by:				
H12 (OLS)	-10.8	3.1	-11.6	-8.6
H12, BMI (OLS)	-9.3	8.1	-4.3	-11.4
H12 (IV)	-151.7	85.9	-163.3	-236.0
H12, BMI (IV)	-145.2	89.8	-156.6	-242.3
Change in participation:	**-0.116**	**-0.007**	**-0.244**	**-0.102**
Explained by:				
H12 (OLS)	-0.001	0.001	-0.002	-0.002
H12, BMI (OLS)	-0.001	0.006	0.000	-0.001
H12 (IV)	-0.009	-0.002	-0.010	0.006
H12, BMI (IV)	-0.008	0.007	-0.009	0.006

Notes:

1. The estimated effect of health on labor supply is the predicted impact of the change in health (H12, or H12 and BMI), reported in Table A3, multiplied by the estimated "structural" effect of health on labor supply (from Tables A4 and A5).
2. OLS refers to predictions based on OLS coefficients, while IV refers to the 2SLS-based coefficients. The benchmark is the estimated labor supply-age profile from Table A3.

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