DISCUSSION PAPER SERIES

IZA

IZA DP No. 832

Joint Labour Supply Dynamics of Older Couples

Pierre-Carl Michaud

July 2003

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

Joint Labour Supply Dynamics of Older Couples

Pierre-Carl Michaud
CentER, Tilburg University and IZA Bonn

Discussion Paper No. 832
July 2003

IZA

P.O. Box 7240
D-53072 Bonn
Germany

Tel.: +49-228-3894-0
Fax: +49-228-3894-210
Email: iza@iza.org

IZA Discussion Paper No. 832
July 2003

ABSTRACT

Joint Labour Supply Dynamics of Older Couples*

This paper studies the labour force participation dynamics of older couples in the United States. Longitudinal data from the five available waves of the Health and Retirement Study (HRS) is used to investigate if the dynamics introduced by considering both spouses' behavior provide additional information in trying to fit observed participation sequences. The paper uses a bivariate dynamic binary choice model with unobserved heterogeneity and serial correlation to disentangle the many sources of dynamics and correlation in a couple's decision making. First, strong true state-dependence is found and results in a bunching of participation and non-participation sequences. Cross-spouse state-dependence is also found which points to indirect effects of social security and pension incentives through complementarity in leisure. Second, the Spouse Allowance program is found to have predicted effects on participation of the couple and these effects are statistically significant. A simulation exercise presents evidence that the elimination of the spouse allowance can raise participation of wives at age 62 by more than the decrease in participation of husbands at age 65.

JEL Classification: J22, J26, C15, C33, C35

Keywords: labour supply of couples, retirement, dynamic panel data models

Pierre-Carl Michaud
P.O.Box 90152
5000 LE Tilburg
The Netherlands
Email: p.c.michaud@uvt.nl

* I thank Arthur van Soest, Jan van Ours, Qin Tu, Charles Bellemare, Rob Alessie and Bertrand Melenberg for their helpful comments. I would also like to thank seminar participants at the 2003 IZA summer school, the Econometric Seminar Tilburg University and the 2003 AGE meeting in Naples for their input. Programs in Ox 3.2 can be obtained from the author. The usual disclaimer applies.

1 Introduction

It is often argued that the race will be between increasing participation of older couples and the decreasing fertility trend in order to predict how large the ageing problem will be in the coming years. Therefore, it follows that one cornerstone of an efficient social security system should be that it can adequately meet the needs of a new generation of elderly, with greater labour market experience than preceding ones. Adding to this policy relevance, the positive trend in labour force participation (LFP) of wives makes the analysis of retirement outcomes of couples, as a generalization of the analysis of "single individuals", an important topic on the economic research agenda (Lumsdaine and Mitchell, 1999). As a matter of fact, one can find in features of the data that joint retirement outcomes are relatively frequent (Hurd, 1990; Maestas, 2001; Gustman and Steinmeier 2002) and conditional probabilities of participation are often very different depending on the lagged participation status of the spouse (Blau, 1997 and 1998). Hence, this suggest that apparent coordination of retirement behavior among spouses is an interesting of research topic both from a positive but also normative perspective.

Can it be useful to consider at all couples in the analysis of retirement decisions?[1] Burtless (1990) rightly points out that as long as a spouse's behavior affects the behavior of another spouse only by introducing some correlation in the unobservables, one need not worry about the consistency of the inference if the investigator concentrates only on single individuals. Indeed, recent studies show that financial incentives have a negligible direct effect on the coordination of labour supply of older couples (Blau, 1997,1998; Gustman and Steinmeier, 2000). Hence, the state of knowledge is that preferences for shared leisure seems to be the most important source of this coordination. For example, Blau's studies point to indirect effects of financial incentives on labour supply of the couple but do not indicate statistically that the spouse allowance, a special feature of the American social security system, affects labour supply of the couple and particularly the joint retirement outcomes.[2] While Gustman and Steinmeier consider an uncertainty free environment for the couple, Blau uses a sophisticated dynamic multinomial probit model for which the interpretation of the results is not straightforward and lacks standard errors to assess the precision of the estimates.[3] In his 1998 paper using the Retirement History Survey (RHS) data from 1969-1979, Blau argues that: "An important task for future research will be to determine if the patterns of behavior documented in this article are still prevalent, or wether these patterns have developed" (p.622).

In this paper, I revisit these issues using the most recent available data from the

[1] Although most authors in this literature interpret their findings in terms of retirement behavior, the decision variable used in most cases is participation in the labor market. One should recognize that retirement is an ambiguous concept since transitions out of retirement are observed frequently (Lumsdaine and Mitchell, 1999).

[2] Under this program, a spouse is entitled to the maximum of her own benefit and half the benefit of her spouse given that he is eligible for social security.

[3] Blau (1997,1998) models the four possible participation states that a couple can occupy allowing for unobserved heterogeneity in each state and state-dependence. Estimation of the full model implies nearly 500 parameters to estimate.

Health and Retirement Study. In particular, I try to address potential shortcomings of the approach taken in both Gustman and Steinmeier (2000,2002) and Blau (1997,1998) by considering very general dynamics in the participation decision of couples using a bivariate dynamic binary choice model with serially correlated errors and unobserved heterogeneity. Since tractability is desirable, I do this by imposing some structure that leaves a straightforward interpretation to the results and enables comparisons with more restrictive models used in the literature (see Coile (2003) and Pozzebon and Mitchell (1989) for example).

I find that based on the first five waves of the HRS, an elimination of the spouse allowance could roughly decrease husbands' participation rates by an average of 1.56 percentage points while it would increase the participation rate of wives by an average of 3.6 percentage points. This points at an overall positive effect of the elimination of the spouse allowance on the participation of couples. Participation decisions are found to depend on the past decisions of both spouses which leads to multiplier effects of social security and pensions. For a representative wife, the evidence suggest that having a husband that worked in the previous year is associated with a 8.3 percentage points increase in the probability of working compared to having a non-active husband. Alternatively, the effect found is estimated to be a 6.4 percentage points increase for the wife's lagged decision on the participation decision of the husband. Moreover, private pension accruals are found to have a significant impact of the participation of wives (3.4 percentage point for 10% yearly accrual) while this effect is smaller for husbands (0.9%). On the methodological side, inferences from models are found to be biased when leaving the dynamics aside. Particularly, the effect of pensions is found to be overestimated in static models and the correlation in unobserved heterogeneity among spouses is imprecisely estimated upon considering cross-spouse state-dependence.

The paper is organized as follow. Section 2 reviews the findings on the different sources of coordination in labour supply of older couples. Section 3 looks at indicators of labour supply dynamics in the five available waves of the Health and Retirement Study. Following this, section 4 presents the effect of introducing state-dependence in a labour supply model for couples. In section 5, the empirical strategy is discussed. In Section 6, I analyze the results and their implications. Finally, section 7 concludes.

2 Sources of Coordination in Labour Supply

Starting with Hurd's (1990) study on the prevalence of joint retirement, a new line of research has emerged trying to investigate the behavior of couples at the eve of retirement.[4] The main question is to find out if coordination in labour supply originates either from the observable preferences, from the financial incentives affecting the budget constraint or from unobservables which are correlated among spouses.

[4] Although Pozzebon and Mitchell (1989) consider the effect of the husband's retirement status on the wife's retirement decision, the focus of their study is on retirement behavior of married women which does not model the behavior of the husband. Jiménez et al. (1999) document the prevalence of joint retirement in 12 European countries.

On the incentive side, the spouse allowance has been the main candidate to explain coordination in retirement dates.[5] Suppose the following common situation for a fictitious couple where John is 65 and Mary 62. John is entitled to a monthly benefit of 1000$ in a given month and suppose that Mary is entitled to a benefit on her own account of 300$. The spouse allowance allows Mary to collect half the benefit of John if this amount is higher than her own entitlement. In this case, the couple gets 1500$ in total. In the next year, the incentives to work will depend on the return that both spouses can get from working. Indeed, if Mary's wage (and increase in monthly benefit) does not bring her benefit above the 500$ threshold there is no gain to reap from her participation in terms of benefits for the household. In this example, even the average increase in benefits of 7% due to the actuarial reduction factor will not bring her benefit to be the binding force.

However, suppose that John considers working an additional year. If he does so, even if his wage does not increase his monthly benefit, his benefit will increase because of the delayed retirement credit of roughly 7% in the actual system. As a consequence, his benefit will increase by 70$ per month while the total benefit available to the couple increases by 105$ per month. Hence, the incentive is to encourage work for the husband and discourage work for the wife if the difference in benefits is such that the owner of the account is the one that increases total benefit at the margin. However, note that if John and Mary had the same benefit entitlement of 650$ in a month, the couple would get 1300$ instead of 1500$. Since earnings inequality is rewarded by such a program, some have argued that the system should move to an income sharing rule (see Blau 1997 for a review of the arguments).

From a similar illustration, Blau (1997) concludes: "It is clear, therefore that married women will supply less labour and their husbands will supply more labour in the presence of a spouse benefit provision than in its absence"(p.378). Surprisingly, when looking at the data from the Retirement History Survey of 1969-1979, Blau finds a relatively small positive effect on participation for husbands and a negative effect for wives, although the statistical significance of those effects cannot be assessed because of computational difficulties.

Thus, he concludes that the evidence suggest that "... equity issues should remain the focus of the debate over the spouse benefit..." (p.414) while in another paper in 1998 more evidence is found that "... these associations [*in retirement dates*] are not explained by financial incentives but seem instead to be a result of preferences for shared leisure" (p.597).[6]

Revisiting his 1997 results, Blau (1998) finds that the dynamics in participation of one spouse are important to explain transitions by the other spouse. Hence, he argues that there are multiplier effects or indirect effects on participation that arise from

[5] See McCarthy (1990) and Vistnes (1994) for a discussion of the effects of the spouse allowance.

[6] Baker (2002) finds that the introduction of the spouse benefit in Canada had the predicted effect of increasing husband's LFP compared to the going trend while wives did not share the rising trend in participation of those not entitled to the benefit. Sédillot and Walraet (2002) find that complementarity of leisure is prevalent but that large penalties for early retirement in the French social security system appear to decrease its effect.

social security incentives but that the spouse allowance does not appear responsible for the simultaneity in participation decisions. Quite plausibly, a potential explanation for these dynamics is that couples prefer to spend time in the same state (complementarity in leisure).

Gustman and Steinmeier (2000) follow a structural approach to investigate the possibility that complementarity in leisure is an important determinant of joint retirement. In a Nash-bargaining process with no uncertainty, the decision of one spouse will depend on the other spouse's decision through the utility function if the marginal utility of leisure is a function of this decision. Nevertheless, upon parameterizing a utility function, the only positive effect found is that of the wife's retirement status in the husband's utility function, which suggests that the complementarity component is not important in the bargaining game. Confirming previous studies' results, they do not find evidence of financial incentives effects. However, they find relatively important correlation between spouse specific unobservables which are interpreted as a taste for retirement.[7] Therefore, when looking at potential explanations of joint retirement, they conclude that "...the taste term plays a very large role in accounting for the large share of ages at which various individuals retire". Additionally, consistent with the result of Blau, they conclude that "... joint retirement is due to preferences and not to the budget set" (p.536). In a sense, the results of Gustman and Steinmeier (2000) send the researchers in the field to the initial dilemma of Burtless who argues that one should not take into account the other spouse's decision if this only introduces correlation in unobservables.

In this paper, I argue that there are many reasons why it is important to revisit these findings. The data used is generally old (from the 1969-89 period) and that in the case of the Gustman and Steinmeier study only workers with important labour force history are selected such that generalizations are difficult to make about labour supply of the elderly in general. Furthermore, their analysis is about retirement as an absorbing state which fails to recognize that in recent years, dynamics out of retirement are more common (Blau,1997).

Moreover, although Gustman and Steinmeier's approach is structural, it suffers from the fact that no uncertainty from the viewpoint of the couple is allowed for in their model. It is assumed that is a one-shot decision made by the couple from which deviations are not profitable latter in life. The estimation problem boils down to a cross-sectional problem but the inference of the effect will not use time-varying unobservables and observables. In this case, it may not be surprising to see few of the covariates having an effect on retirement outcomes. Moreover, there is a risk that the unobserved heterogeneity correlation will incorporate the correlation in time-varying shocks which has very different implications for the dynamics if such dynamics are present.

Furthermore, considering such Nash-bargaining models leads to the famous incomplete estimation problem with multiple equilibrium and for which only ad hoc solutions

[7] Christensen and Datta Gupta (1994) find evidence of complementarity of leisure from such correlation. Coile (2003) and Maestas (2001) find evidence of this from subjective data on preference for shared leisure which is associated with small differences in retirement years.

exist (see Tamer (2002) for recent solutions in cross-sections). In Gustman and Steinmeier's papers this problem is "solved" by assuming that in case of a multiple solution, the spouse who retires first commits the other to its preferred equilibrium. If this assumption is incorrect, it is likely to lead to inconsistent estimates.[8]

On the other hand, Blau's multinomial probit model does not address directly the return for the couple of the spouse allowance which translates into non-linear effects of benefits of both spouses. In both 1997 and 1998 papers, the potential for serially correlated errors is not addressed and the correlation between both spouse's unobservables cannot be easily derived for comparison with other results. Furthermore, because of reported computational difficulties, standard errors are not reported which limits the inference that can be done from the results. Therefore, the challenge is to impose some plausible restrictions on Blau's approach that will get rid of the computational complexities without altering the generality of the conclusions. From a methodological standpoint, it is also important that we understand what are the gains from flexibility in dynamics compared with static models.

3 Data and Descriptive Analysis

The Health and Retirement Study is a longitudinal survey of individuals aged 51-61 in 1992 in the United States. The project started in 1990 and was funded by the National Institute on Aging and other partners such as the Social Security Administration. Data was collected every two years and covers a wide range of aspects of the life of elderly couples. For the first wave of 1992, 12,652 interviews were performed from a random sample of individuals born between 1931 and 1941 inclusively. The spouse of these individuals was automatically included in the sample even in the case were he/she was not eligible. This gives equally detailed information on both partners of a couple.

I use the public release from the RAND organization that merged records from the 5 available waves.[9] Data is arranged by match (couples) consisting of a respondent and his spouse. The matches are observed over 5 possible periods each covering two years. Deleting observations with important missing information, I am left with 2,928 couples followed over five waves covering ten years (1990-2000).

An individual is defined as employed (L) if he/she is working for pay at the time of the interview and this includes those working full-time or part-time. In the sample, we have that the employment rate is 77.4% (60.9%) for husbands (wives) in 1992. About half of the couples enter the sample with both participating. The trend in employment rate is negative as one would expect and employment rates fall to 49% (43.7%) in 2000 were the cohort followed is aged between 61 and 71. Finally, the difference in employment rates gets smaller with time meaning that labour force attachment of husbands falls more rapidly than that of wives over the period.

Table 1 presents biannual transition matrices for males with conditional proportion

[8] Maestas (2001) faces the same problem and assumes that only the wife's participation decision enters the husband's decision.

[9] http://www.rand.org/labor/aging/dataprod/

of those in a state staying or moving to another state. A far greater number of working individuals continue to do so while a far greater number of individuals who are not working stay in this state. This suggest that there is potentially state-dependence. However, from this transition matrix one cannot see if this is due to the mover-stayer effect, the fact that individuals differ intrinsically in their probability of moving therefore creating spurious dynamics due to selection, or if it is due to true state-dependence such that something happens in a state that makes someone more likely to stay in this state.

[TABLE 1 ABOUT HERE]

We can also look at the different combinations of labour force participation over the five waves. In table 2, such frequencies can be found for husbands and wives. There is considerable inertia in the transitions to suggest that there is state-dependence. Interestingly around one fifth of all transitions for husbands and wives feature reverse permanent flows into participation (0xxx1 sequences).

[TABLE 2 ABOUT HERE]

One informative exercise is to look at the difference between the probability of working for pay for one spouse conditional on the state that the other spouse occupied. From table 3, we can see that the probability that a wife works is 20.3 percentage point higher if the husband also worked in the previous period. This could be due to many things, matching of taste for work (assortative mating), true state dependence, similar characteristics, etc. For husbands, this difference is fifteen percentage points which is still relatively high. Finally, this effect increases by six percentage points for husbands over the ten year period while it increases by four percentage points for wives.

[TABLE 3 ABOUT HERE]

If one looks at the joint transitions which are the primary object of analysis (table 4), then state-dependence appears the strongest when both spouses occupy the same state which may be an indication of complementarity in leisure. It is also interesting to note the important number of transitions out of non-participation which suggest that an analysis considering retirement as an absorbing state misses important information on the interactions between spouses.

[TABLE 4 ABOUT HERE]

From these observations, it is apparent that an adequate model should account for the grouping of participation decisions across time. Moreover, it should answer why there is a dependence of a spouse's decision on the previous decision of the other spouse and finally, why couples prefer to occupy the same state and make transitions in the same time interval.

4 State-Dependence in a Labour Supply Model

The purpose of this section is to study how reservation wages are affected by the state in which the couple is at the time of their decision. Traditionally, in a unitary framework, resources of the household are pooled and the optimal outcome is the one that maximizes an intertemporal household utility function. Assuming intertemporal separability of the utility function and exponential discounting, the expected present value of utility at period t is given by

$$U_t = \sum_{s=0}^{\infty} \psi^s \mathbf{E}_t u(C_{t+s}, \mathbf{h}_{t+s}, \mathbf{x}_{t+s}) \tag{1}$$

where u is the subperiod utility and $\mathbf{x}_{t+s} \in \mathbb{R}^K$ is the period $t+s$ characteristics of the household. The controls are C, pooled consumption, and $\mathbf{h} = (h_m, h_f)' \in \{0,1\} \times \{0,1\}$ are the participation controls for the spouses which are assumed discrete.[10] Finally, the discount rate is $0 \leq \psi < 1$ and $\mathbf{E}_t$ is the conditional expectation over the uncertainty space in $\mathbf{x}_{t+s}$ $(s = 0, ..., \infty)$ using information up to t.

A dependence of the participation decision of a spouse on the decision this same spouse took in the preceding period can be motivated by a search process for unemployed spouses (Hyslop, 1999), involving increasing costs with age. Indeed, this could be a consequence of labour market rigidities at older age (Hurd, 1996). On the one hand, Lumsdaine and Mitchell (1999) document the possible labour market rigidities that may exist on the old age segment of the labour market. One such indication that they report is that approximately 12-15% of workers feel they are discriminated against because of their age according to the first wave of the Health and Retirement Study (HRS).

On the other hand, there are other ways by which the functioning of the market and institutions that affect it can reduce mobility and flexibility for older workers. These ways are surveyed by Hurd (1996). Among them is job-specific human capital investment which would induce firms to prefer younger workers because the returns to investment in their human-capital can be obtained over a longer period. Furthermore, since economic sectors evolve through time, human capital investments that were made in a period when they were valuable may not be valued anymore as new technologies replace others.[11] As a consequence, these factors motivate the possibility that rigidities can create state-dependence which may be severe for older workers. One way to parameterize these rigidities is to write the budget constraint for period t as[12]

$$C_t = y_t + w_t' \mathbf{h}_t - \gamma' \left[(\iota - \mathbf{h}_{t-1}) \circ \mathbf{h}_t \right] \tag{2}$$

where w_t is the wage vector in period t and $\gamma = (\gamma_m, \gamma_f)' \in \mathbb{R}^2_{++}$ is the vector that captures the search cost associated with participating in the labour market in case the

[10] The subscript m refers to the husband and f to the wife.

[11] Another rigidity often mentioned is hours constraints. The fact that workers seldom go back to work in the same industry following a quit from a long-term job could also be suggestive of hours constraints if they are constant across industries because of team-work arrangements or other synergy mechanisms.

[12] Assuming away savings simplifies the exposition but results would remain qualitatively the same.

spouse did not participate in the previous period. Finally, $\circ$ is the element-by-element product and ι is a unit vector. Occupying the state of non-participation does not imply that a spouse is consuming resources to search. This is particularly realistic for this age segment where non-participation is more likely to be retirement than unemployment. Therefore, the costs of search are absorbed by the couple upon accepting to participate which is more in-line with the stylized facts that feature difficulties for the elderly to re-enter the labour market. Hence, the analysis will differ from that of Hyslop (1999) who explicitly tying search costs to the state of non-participation irrespective of the decision made by the spouses.

If wages and non-labour income are both from stationary processes, the value function for period t's decision is given by $V(\mathbf{h}_{t-1}) = \max_s \{V^s(\mathbf{h}_{t-1})\}$ where s is a combination from $\{0,1\} \times \{0,1\}$. Each alternative's value function (suppressing $\mathbf{x}_t$ for simplicity and the reference to time) is given by

$$V^s(\mathbf{h}_{t-1}) = u(y + w's - \gamma' [(\iota - \mathbf{h}_{t-1}) \circ s], s) + \psi V(s). \tag{3}$$

First, we can define reservation wages for both spouses holding the other spouse out of the labour force,

$$\begin{aligned} w_0^m(\mathbf{h}_{t-1}) &: V^{10}(\mathbf{h}_{t-1}|w_0^m(\mathbf{h}_{t-1})) = V^{00}(\mathbf{h}_{t-1}) \\ w_0^f(\mathbf{h}_{t-1}) &: V^{01}(\mathbf{h}_{t-1}|w_0^f(\mathbf{h}_{t-1})) = V^{00}(\mathbf{h}_{t-1}). \end{aligned} \tag{4}$$

The subscript denotes the state of the other spouse on which the reservation wage is conditioned. I proceed in a similar fashion to Hyslop (1999) to show how reservation wages are affected by the state occupied by the couple. Taking first the outcome where only the husband is considering working, we see that

$$V^{10}(\mathbf{h}_{t-1}|w_0^m(\mathbf{h}_{t-1})) - V^{10}(\mathbf{0}|w_0^m(\mathbf{0})) = V^{00}(\mathbf{h}_{t-1}) - V^{00}(\mathbf{0}) \tag{5}$$

holds as a result of (4). In addition, note that $V^{00}(\mathbf{h}_{t-1}) = V^{00}(\mathbf{0})$ since the value of not-participating is not affected by the choice that the couple made in the previous period (search cost are absorbed only by non-participants entering the labour market). As a result, (5) involves the equality

$$\begin{aligned} & u(y + w_0^m(\mathbf{h}_{t-1}) - \gamma_m(1 - h_{mt-1}), 1, 0) \\ = \; & u(y + w_0^m(\mathbf{0}) - \gamma_m, 1, 0) \end{aligned} \tag{6}$$

which immediately yields the desired equivalence between the two reservation wages,

$$w_0^m(\mathbf{h}_{t-1}) = w_0^m(\mathbf{0}) - \gamma_m h_{mt-1}. \tag{7}$$

Symmetrically for the case where only the wife is looking to participate,

$$w_{0,01}^f(\mathbf{h}_{t-1}) = w_{0,01}^f(\mathbf{0}) - \gamma_f h_{ft-1}. \tag{8}$$

The reservation wage of the wife holding the husband out of the labour force will not depend on his lagged decision because there will be no income effect arising from his search costs. Her search costs will be entirely absorbed in the wage asked to make her indifferent between participating and not participating. The unambiguous effect of search costs in these two cases will be to increase the participation probability of a spouse, holding the other not participating, if that spouse did work in the previous period.

Alternatively, if one considers the reservation wages of both spouse holding the other spouse participating, these will be a function of the market wage of the other spouse. Define

$$\begin{aligned} w_1^m(\mathbf{h}_{t-1}, w^f) &: V^{11}(\mathbf{h}_{t-1}|w_1^m(\mathbf{h}_{t-1}, w^f)) = V^{01}(\mathbf{h}_{t-1}) \\ w_1^f(\mathbf{h}_{t-1}, w^m) &: V^{11}(\mathbf{h}_{t-1}|w_1^f(\mathbf{h}_{t-1}, w^m)) = V^{10}(\mathbf{h}_{t-1}). \end{aligned} \tag{9}$$

Once again using (9) the following equality holds

$$V^{11}(\mathbf{h}_{t-1}|w_1^f(\mathbf{h}_{t-1}, w^m)) - V^{11}(\mathbf{0}|w_1^f(\mathbf{0}, w^m)) = V^{10}(\mathbf{h}_{t-1}) - V^{10}(\mathbf{0}) \tag{10}$$

which simplifies to

$$\begin{aligned} & u(y + w_m - \gamma_m(1 - h_{mt-1}), 1, 0) - u(y + w_m - \gamma_m, 1, 0) \\ = \; & u(y + w_m + w_1^f(\mathbf{h}_{t-1}, w^m) - \gamma'(\iota - \mathbf{h}_{t-1}), 1, 1) \\ & - u(y + w_m + w_1^f(\mathbf{0}, w^m) - \gamma'\iota, 1, 1). \end{aligned} \tag{11}$$

Using first-order Taylor expansions (for small search costs) on the L.H.S around $y + w_m$ and around $y + w_m + w_1^f(\mathbf{0}, w^m)$ on the R.H.S of (11), one obtains

$$w_1^f(\mathbf{h}_{t-1}, w^m) - w_1^f(\mathbf{0}, w^m) \approx -\gamma_m^* h_{mt-1} - \gamma_f h_{ft-1} \tag{12}$$

where $\gamma_m^* = \left(1 - \frac{u_C(y+w_m,1,0)}{u_C(y+w_m+w_1^f(\mathbf{0},w^m),1,1)}\right)\gamma_m$ is the relative marginal utility loss to the couple of search cost holding the other spouse participating.[13]

Holding the wife participating, the approximation of the husband's reservation wage correspondence is given by

$$w_1^m(\mathbf{h}_{t-1}, w^f) - w_1^m(\mathbf{0}, w^f) \approx -\gamma_f^* h_{ft-1} - \gamma_m h_{mt-1} \tag{13}$$

where $\gamma_f^* = \left(1 - \frac{u_C(y+w_f,0,1)}{u_C(y+w_f+w_1^m(\mathbf{0},w^f),1,1)}\right)\gamma_f$.

There are three effects on reservation wages of lagged participation of the spouse which are apparent in γ_f^* and γ_f^*.

First there is an negative income effect if the utility function is concave and $w_1^m(\mathbf{0}, w^f)$ is strictly positive. This effect tend to suggest that a spouse's lagged decision should

[13] $u_C()$ is the marginal utility of consumption.

have a negative effect on participation. This effect will increase if the is high risk aversion or if $w_1^m(\mathbf{0},w^f)$ is high. Second, if leisure is a normal good ($\partial w_1^f(\mathbf{0},w^f)/\partial w^f > 0$) the market wage obtained by the other spouse will have yet another negative income effect on the gains from lagged participation for the other spouse. It will lower (in absolute terms) the relative marginal utility loss of search costs to the one spouse holding the other spouse participating. Third, if $u_C(C,1,1) > u_C(C,0,1)$ for a given level of consumption, there is a positive relative marginal utility loss to the working couple from not participating in the previous period. The magnitude of this effect will depend on the nature of the goods consumed (public vs private) and the actual degree of complementarity in leisure of both spouse.

Wether $w_1^m(\mathbf{h}_{t-1},w^f)$ or $w_0^m(\mathbf{h}_{t-1})$ (similarly for the wife) is relevant in for a particular decision is endogenously determined and depends on the form of the utility function. Note that only $w_1^m(\mathbf{h}_{t-1},w^f)$ depends on the lagged participation decision of the other spouse while both reservation wages depend on the lagged participation decision of the spouse in the same way. Complementarity in leisure would tend to make $w_1^m(\mathbf{h}_{t-1},w^f)$ lower than $w_0^m(\mathbf{h}_{t-1})$ but again there are income effects that do not enable to conclude on the relevant reservation wage for the decision of the spouse. This will depend among other things on the degree of complementarity in leisure, the curvature of the utility function, the market wage of the other spouse and the lagged participation status of that spouse.

The model generates two predictions with respect to the effect of search costs. First, from estimates of a participation equation of a spouse with lagged participation of both spouses, the predicted effect of that spouse's lagged participation is anticipated to be positive because of search costs. Second, the other spouse's lagged participation will tell, based on the model just developed, if the income effects or substitution effect dominate. In the later case, the effect will be positive, a spouse's participation probability will raise if the other spouse worked in the preceding period. In fact, the sign of the estimated cross-spouse state-dependence "identifies" if there is sufficient "complementarity" in the couple's decision making to overturn the income effects. From table 3, a first indication is that the complementarity effect appears to dominate. Naturally, a more in-dept analysis is needed since assortative mating is clearly an alternative explanation for this observed behavior.

5 Empirical Analysis

5.1 Econometric Model

For each couple i, I observe in the HRS data a sequence $\{h_{mit}, h_{fit}, \mathbf{x}_{mit}, \mathbf{x}_{fit}, \mathbf{z}_{mi}, \mathbf{z}_{fi}\}_{t=1}^{T}$ of labour force participation h and some strictly exogenous variation (from labor force participation) in attributes of the choice environment $\mathbf{x}$ varying over time and $\mathbf{z}$ some time-invariant attributes of the couple. I want to model the probability of observing the sequence $\{h_{mit}, h_{fit}\}_{t=1}^{T}$ for household i given these attributes. Drawing on the theoretical model of the previous section, a natural candidate is the following latent data generating process which represents the excess utility from labour force participation of each spouse for the household utility,

$$\begin{aligned} h^*_{mit} &= \mathbf{x}'_{mit}\beta_m + \mathbf{z}'_{mi}\gamma_m + h_{mit-1}\varphi_{mm} + h_{fit-1}\varphi_{mf} + \eta_{mit} \\ h^*_{fit} &= \mathbf{x}'_{fit}\beta_f + \mathbf{z}'_{fi}\gamma_f + h_{mit-1}\varphi_{fm} + h_{fit-1}\varphi_{ff} + \eta_{fit}. \end{aligned} \tag{14}$$

Finally, the observation rule is given by $\tau(h^*_{jit}) = \mathbf{1}_{[0,\infty)}(h^*_{jit})$ for $j = m, f$. In a random effect setting, where $\eta_{jit} = \mu_{ji} + \varepsilon_{jit}$, the identifying assumption is that μ_{ji}, the spouse specific unobservable (to the econometrician) should be independent of the regressors in vectors $\mathbf{x}_{jit}, \mathbf{z}_{ji}$. Yet, the assumption is particularly doubtful for social security incentives. Indeed, it is likely that spouses with high unobserved labour force attachment will also have better benefit prospects which would lead to an upward bias on the effect of this variable. One way to control for this possibility is to resort to correlated random effects (Chamberlain, 1984). Specifically, I will assume a flexible form $\mu_{ji} = \sum_{s=1}^{T} \delta_{js} w_{jis} + \alpha_{ji}$ where δ_{js} are parameters to estimate and w_{jis} are the wages of both spouses.

Turning now to dynamics in unobservables, a flexible configuration is allowed. Particularly, the spouse specific unobservables $\alpha_i = (\alpha_{mi}, \alpha_{fi})'$ are assumed independently distributed over couples with variances $\sigma^2_{\alpha j}$ and correlation coefficient ρ_α. Moreover, the transitory errors $\varepsilon_{it} = (\varepsilon_{mit}, \varepsilon_{fit})'$ are assumed to follow a stationary diagonal VAR(1) process with AR coefficients $\rho_{\varepsilon j}$ and finally, innovations $\mathbf{v}_{it} = (v_{mit}, v_{fit})'$ are assumed distributed independently over couples according to a bivariate normal distribution with variances σ^2_{vj} and correlation ρ_v.

The lagged endogenous variable, although pre-determined, is present on the right hand side of both spouses' equations. It is by construction correlated with the spouse unobservables (both because of heterogeneity and serial correlation) ,therefore, leading to inconsistent estimates if this correlation is not properly taken into account. Hence, I use Heckman's (1981) approximation to partially take account of the problem by approximating the probability at period 1 which seems to work well in simulations (Chay and Hyslop, 2000). Parameters are allowed to be different in the first period and errors are freely correlated with other period's errors. In short, the interpretation is that this first probability is a reduced form solution where lagged participation has been recursively substituted out.[14]

To summarize and relate to the discussion in the literature, there are two types of correlation between the spouses' labour supply apart from the initial condition correlations and their main purpose is to separate the time-varying and time-invariant effects in the correlation found in Gustman and Steinmeier (2000). On the one hand, the permanent component correlation, ρ_α, which takes account of assortative mating. For instance, people with similar tastes for work may naturally match together or potentially there is a division of labour within the household which affects their reservation wage. One should note that the strict exogeneity of benefits (assuming the correct functional form) can be tested using $H_0 : \delta_s = 0$ for $s = 1, .., T$. On the other hand, there

[14] Results for initial condition are not reported in the tables but can be provided by the author upon request. Although the magnitude of the parameters is different the signs of the effects do not change compared with the main equation's results. See Appendix A for details.

is another correlation allowed for transitory errors ρ_v. Plausibly, unforeseen events that occur in time may well be correlated among spouses, for example because both spouses share a similar living environment. Since it is the correlation in decisions in a given time period, positively correlated unexplained variability of their decisions can be an indication of the degree of complementarity in leisure of the utility function. Finally, the diagonal vector auto-regressive structure in the transitory errors allows for a lasting effect of correlated transitory errors over time. Hence, serial correlation, unobserved heterogeneity and state-dependence all may contribute together to explaining the dynamics found in labour force participation of couples.

For identification of this binary choice model, some normalization is imposed on the covariance matrix. This is discussed along with the derivation of the likelihood contributions in appendix A. To a large extent these are the same as those imposed in Hyslop (1999) for the univariate case. Based on the distributional assumptions, the likelihood contribution of couple i is the probability that the sequence of labour force participation is observed conditional on the strictly exogenous regressors and a parameter vector grouping all parameters to be estimated. This probability consists of a ten dimensional integral which is simulated using the GHK (Geweke, Hassivassiliou and Keane: see Hajivassiliou et al. 1997) probability simulator. In this respect, I make use of pseudo-random draws from the uniform distribution and I use Halton sequences which have good coverage and variance-reduction properties (Train, 2002).

6 Specification and Results

6.1 Specification

Standard demographic variables such as age of both spouse, schooling and race are included in the specification. Furthermore, I include the number of marriages the individual had to proxy cohesion between spouses as this may be a function of the time they have been together. Two measures of health are included. The “activities of daily living index” (ADL index) is the sum of 0-1 answers to questions about different difficulties to perform such tasks as to cook, dress, bathe, walk around the room and to get out of the bed. It is used to capture the effect of long-term physical difficulties. The health index ranges from one to five, five indicating that the respondent evaluates that he is in poor health. In addition, I also include the other spouse’s health status into the specification to capture caring activities which may take away available time to work for the spouse. Both spouses’ lags are also included in the specification for dynamic models to allow for long lasting effects of health changes (Smith, 1999).

Turning now to financial variables, pension accruals are defined as the percentage difference between the expected present value of pension wealth at the given ages. These present values are based on scenario one of the work of Peticolas and Steinmeier (1999) which uses plausible assumptions about interest rate and inflation rate. They use the data from the Employer Pension Study conducted by the HRS in 1992. This data is merged to the RAND files on couples. Since pensions are calculated every five years, only two such accruals are considered, one from 55 to 60 year old and one from 60 to 65. I acknowledge that this aggregation may be missing some of the important nonlinearities in incentives. Once an individual reaches the upper bound of the age group, the accrual is set to zero. Moreover, individuals without pension plans are assigned a value of zero for these accruals. To summarize, one can interpret the accruals as an incentive to work if they are positive and since they are set to zero once the individual reaches the upper age bound the effect can be interpreted as a forward looking effect of pension accruals. In addition, the household capital income is included to measure the effect on participation of non-labour income but also potentially captures any responsiveness to the change in capital income due to financial market fluctuations.

Since I do not have access to restricted data portion of the HRS containing the main element of the old age insurance, the average indexed monthly wage, I resort to an approximation of this quantity by using the average of the wages of a spouse. This may be a correct measure if spouses do not reduce hours at the intensive margin when approaching retirement and if their wages do not increase or decrease significantly as they approach retirement. They are based on the imputed wage correcting for sample selection. Yet, the corrections are not used in the final imputation to avoid simultaneity bias. The details of the imputation process which takes account of selection in unobservables to retrieve population parameters using Vella and Verbeek's (1999) two-step estimator are found in appendix B along with the details of the computation of social security benefits.

One of the primary interests of the present investigation is to capture potential spouse allowance incentives. A wife (husband) is entitled to half her(his) husbands' (wife's) entitlement if that amount is larger than her (his) own entitlement, conditional on her (him) being eligible. One way to construct a measure of this incentive is to compute the immediate return to the total benefit of the couple from the spouse allowance as a percentage of total household social security income, $s_{mit} = \mathbf{1}_{(0,\infty)}(0.5b_{mt} - b_{ft})\frac{0.5b_{mt}-b_{ft}}{1.5b_{mt}}$ and similarly for the spouse allowance available to the husband where b_{mt} and b_{ft} are the imputed benefit entitlement of each spouse in period t. This kind of non-linearities in the incentives and the way they evolve in time could explain why just including both spouses' benefits is not sufficient to capture the effect of the spouse benefit. We can still use this measure to capture a forward looking aspect if the wife (husband) is not eligible at t. For instance, I then replace b_{ft} by the benefit the wife would get at 62. Hence, identification comes from institutional variation in the age path of benefit plus the variation across couples in wage potential differences since the correlated random effects specification controls for the cross-section variation in wages.

6.2 Results

I proceed in the following way to assess the effect of introducing dynamics and correlation in the labour supply behavior of older couples. First, I report static probit estimates for each spouse imposing the correlation to be zero between equations. This mimics the strategy used by Coile (2003) to assess the effect of social security on the behavior of couples although I consider unobserved heterogeneity as an additional source of variation in the unexplained part of the error term. Then I introduce correlation among decisions both in permanent unobserved heterogeneity and in the transitory errors without introducing other dynamics. This mimics in a reduced-form way the analysis done by Gustman and Steinmeier (2000,2002) since the dependence of each spouse's decision on the decision of the other will be found in the correlation in transitory unobserved errors while there will also be correlation in preferences which they interpret as taste for work. This should not change the parameter estimates but could potentially result in efficiency gains.

The third set of estimates will investigate dynamics introduced by state-dependence (SD hereafter) in each spouse's equation separately without allowing for correlation among spouses. This will be close to the work of Hyslop (1999) for participation of younger married women from the PSID. After assessing its possible impact on the estimates, I will then allow in a last set of estimates the decisions to be correlated and allow for cross-spouse SD as presented in the model of section 5. Note that all three previous set of estimates are nested in this last model such that likelihood ratio tests can be used to test them against the more general counterparts. These estimates along with the marginal effects for both bivariate models are reported in table 6 and 7. Moreover, I will perform a goodness-of-fit exercise to compare the performance of the static and dynamic bivariate probit.

Inasmuch as wage imputation is used in the same way for all model, let us first look at the results. From table B.1 in the appendix the joint hypothesis of no sample selection is rejected for both spouse. Both Gustman and Steinmeier (2000,2002) and Blau (1997,1998) do not take account of selection in their imputation techniques. The results show that selection is found to come primarily from person-specific characteristics which also illustrates that the simple Heckman procedure (selecting on time-variant unobservables) is not enough in this longitudinal data setting.[15]

6.2.1 Static Univariate Probit Model Estimates

Coile (2003) considers a model of spouse behavior where both equations are independent of each other (no correlation in unobservables) and where no dynamics are allowed for (state-dependence or serial autocorrelation). The assumptions in the general model are therefore that the correlation parameters are set to zero and that neither lagged dependent variables nor serial correlation are present in the process. The first two columns of table 5 report the results for the specification mentioned in the previous section using the static univariate probits.

[TABLE 5 ABOUT HERE]

Once can see that the share of unobserved heterogeneity is estimated to represent 3/4 of the total variance in the error component. This share is estimated to be statistically higher for wives than for husbands. Note that the correlated random effect

[15]Estimating cross-sectional sample selection models will capture selection in both unobservables but will not be able to disentangle them. Furthermore, this technique is likely to be less efficient.

specification is used in this set of estimates and that the restrictions are easily rejected ($H_0 : \delta_s = 0 \ s = 1, ..., T$). Not surprisingly, the effect of age is to decrease participation as one would expect and as found in the descriptive analysis. Moreover, the husband's participation rate falls faster than the wife's participation rate controlling for cohort effects (which do not seem to be present constrained in a linear form). The age of the spouse controlling for own age has the unambiguous effect of decreasing participation rates. Another interesting result is that individuals who have been married many times tend to participate less than those who have been married only once.

As found in other studies, health deterioration is one of the primary factors affecting participation at advanced age. Both measures, ADL and self-reported health status show significant effects. Particularly, the addition of one difficulty in performing daily living tasks is estimated to have nearly twice the effect that an additional year of age has. This effect is smaller (1-year) for the self-reported health status although it is difficult to compare the two measures since they are scale-dependent. The effect of a change in the ADL index has a bigger impact for wives than for husbands (not shared for subjective health) while wives tend to respond marginally to a deterioration of the subjective health of their husband by increasing participation (only significant at 10%).

Coming now to the incentive variables linked to retirement, a first interesting element is the gender difference in the effect of private pension accruals. As expected, positive accruals give incentives to stay longer in the labour market and they are most predominant in the 55-60 window (Lumsdaine and Mitchell, 1998). Wives tend to respond more than husbands to these incentives and this result was also found by Blau (1997).

Finally, benefits from the spouse allowance on the husband's account appear to give a disincentive for the wife to work as predicted by Blau (1997). This effect is about twice as large as the effect of age for a 10% increase in the spouse allowance. No positive incentive effect is found for the husband and no effect is found for couples entitled under the wife's social security account.

6.2.2 Static Bivariate Probit Model Estimates

The likelihood ratio test for the restrictions imposed in the separate probits of the previous section rejects these at the 1% level ($LR = 175.7; \chi^2_{(2),0.01} = 9.21$). Nonetheless, under the random effect assumption these restrictions should not bias the parameter estimates. Indeed, this is exactly the result that underlined Burtless' comment on the usefulness of considering couples. As a matter of fact, estimates in the second and third column of table 5 show that no efficiency gains are realized and that parameter estimates remain virtually the same.

[TABLE 6 ABOUT HERE]

The additional information that we get is that there is both correlation in the decisions of each spouse because of similar taste for work and because otherwise unexplained variation in their decisions seems to be correlated, indicating a form of complementarity in leisure since these cannot be due to benefit incentives. Note that the result on the correlation in taste for work is roughly the same as that found in Gustman and Steinmeier (2000,2002). Yet, if the exercise stopped there we would conclude that preferences appear to matter enough for cohesion and that incentives affect each spouse's behavior.

6.2.3 Dynamic Univariate Probit Estimates

Along with introducing dynamics in participation we also introduce lags of subjective health status. Therefore, the static and dynamic models are not directly comparable because simultaneous changes are made to the specification. The resulting likelihood ratio test statistics reject for both spouses the restrictions imposed by the static probit and the restrictive dynamics in health.

More importantly, the results reported in columns 5 and 6 of table 5 also show that the apparently high share of unobserved heterogeneity was in fact due to state-dependence (SD). Indeed, the share of unobserved heterogeneity drops by more than 2/3 compared to the static probit estimates. Hence, the results suggest that SD is the primary determinant of participation for both spouses. In fact, this is in-line with the general belief that there are costs to transition, that render retirement, consecutive periods of non-participation, as an optimal behavior for most individuals. These results confirm is that non-participation is not only due to incentives (shifts in the budget set which yield corner solutions) and to preferences (shifts in the indifference curve with age) but also to adjustment costs in the form of rigidities (Blau, 1998).

Looking at the last dynamic component of the model, the AR(1) parameters are found to be negative for both spouse which is indicative of misspecification of the dynamics. Since the time span is short, I do not have many degrees of freedom to alter the dynamics by including more lags of participation. It is interesting to note that this result is very similar to that found by Hyslop (1999) for younger wives using the PSID.[16] More importantly, neglecting the AR(1) structure does not change results for the conditional mean function of both equations but increases marginally the share of unobserved heterogeneity which is mirrored in the opposite direction for the SD parameters.

Comparing with results from the static models (both bivariate and univariate), the marriage effect and racial effect disappear for husbands while the racial effect remains for wives. This result indicates different participation behavior among non-white wives at older age. The age effect decreases for both spouses after the introduction of dynamics which could be interpreted as a sign that there are increasing adjustment costs with age. However, the interaction term of the participation status with age are both insignificant. Since dynamics in health have been included, the accumulated effect of a health shock on participation probabilities was potentially captured by the age effect.

Although there does not appear to be any dynamic effect on participation from

[16] The initial correlations are also very similar to those of Hyslop (1999). I tried experimenting with the dynamics in health to see if this could be the cause. The results were still negative for the serial correlation. Estimation AR(1) linear probability models also reveals negative serial-correlation. These results can be provided upon request.

changes in the ADL index, the effect is now much stronger than in the static case (relative to the age effect) which could be could expected since lagged participation is negatively correlated with changes in the ADL index. Dynamic effects are found for subjective health status with the cumulative effect being similar now to the effect of a one-time change in the ADL index. Long-term changes in the subjective health status are likely to be positively correlated with increasing difficulty to perform daily living activities which are usually indications or long-term mobility and health problems. The income effect for wives associated with a deterioration of their husband's subjective health status remains and increases upon considering participation dynamics. As always, the causal interpretation of the correlation between health changes and transitions should be made with extreme caution (Smith, 1999).

The effect of pension accruals from 55 to 60 years old decreases substantially as a ratio of the age effect. As marginal effects in table 6 shows, the effect for wives goes from 1.02 to 0.69 year equivalent with a similar decrease for husbands for a one percent change in the accrual. It is important to note that the gender difference remains after allowing for dynamics. This is similar to results found in Blau (1997).

Important negative participation effects from the spouse allowance are found from these estimates for the receiving spouses. From these estimates, it is clear that the spouse allowance on the husband's account has a net negative participation effect at the level of the couple. Since no effect is found for wives on their own account, there is again a net negative effect on the participation of the couple from the spouse allowance.

The next step is to introduce correlation in the decisions and further allow participation decisions of each spouse to depend on past decisions of the other spouse as suggested by the figures in table 3 and see if these modify the effects found in the univariate dynamic case.

6.2.4 Bivariate Dynamic Probit Model Estimates

Since the univariate dynamic models are nested in the bivariate dynamic model it is first interesting to assess the statistical validity of the restrictions by a likelihood ratio test. Such a test yields a value of 169.8 ($\chi^2_{(5),0.95} = 11.07$) which leads clearly to the rejection of those restrictions.

The age effect corresponds to the observed decline in participation rates observed in the data. From 50 to 65, the predicted decline in participation for males is 30% which is roughly the observed decline (from 77% to 49%). Similar figures are obtained for wives.

Comparing the dynamic features of the present model with the previous set of estimates using the last two columns of table 5, we see that the SD parameters do not change significantly for husbands while the wife's state-dependence parameter increases considerably. In addition, the share of unobserved heterogeneity in the total variance remains constant for both spouses. The AR(1) parameter estimates mimic those in the univariate case and the initial condition estimates are similar. Finally, the SD effects are considerable with husband and wives having roughly 62% higher participation probabilities if they were participating in the previous period (Table 6). Adjustment cost appear to be important enough so that a marginal change in the wage and therefore benefit can have a substantial long-term effect on participation if many couples are near the extensive margin of participation.

The cross-spouse effects are found to be statistically significant while moderate in the case of the effect of the wife's state on the participation propensity of the husband (p-value 6.3% for the wife's effect on the husband's probability). Moreover, the gender asymmetry is statistically significant. Therefore, financial incentives such as private pension can trigger indirect effects on the participation of the other spouse who is found to be 6.4 percentage point for the wife's effect on the husband (and 8.3 percentage point for husband's on the wife). Figure 1 presents the result of a simulation exercise where these cross-SD parameters have been restricted to zero (not re-estimated).

[FIGURE 1 ABOUT HERE]

Neglecting cross-SD shifts upward transition rates out of the labour force for both husbands and wives as can be seen in the top panel. Interestingly, transition rates into the labour force in the lower panel do not change significantly for husbands while they decrease for wives suggesting that the aggregate effect of cross-spouse state-dependence is stronger for wives than husbands for re-entering the labour market. Although it is very tempting to identify this effect as a sign of complementarity in leisure, it cannot be undoubtedly disentangled from other possible effects. These results are consistent with the substitution effect dominating both income effects in the model developed in section 4. A structural analysis under such a rich error structure being nearly impossible it is perhaps best to use this as additional evidence of complementarity in leisure in addition to the statistically significant correlation in unobserved transitory errors. The correlation between the two unexplained transitory errors in the decision of spouses is estimated to be 0.16. However, the results suggest that upon taking into account cross-state dependence, the apparent latent correlation in attitude towards the labour market (taste-for-work as Gustman and Steinmeier called it) is imprecisely estimated. Hence, this result illustrates that it is important to identify the source of this correlation since both do not lead to the same conclusions.

For a 50% negative accrual over 5 years from private pensions (10% per year), the model estimates suggest that participation probabilities in a given period are reduced by 3.4 percentage points for wives while the effect is only 0.9 percentage points for husbands. Interestingly, accumulated over the five year term of such an accrual this figure is important. However, the fact that we imperfectly measure the accrual at 5 year intervals limits the extrapolation of the long term effect of the incentive. Since there are indirect effects, early retirement incentives can trigger retirement of one spouse and weaken the labour force attachment of the other spouse. Hence, the generosity of private pension plans can have multiplier effects which are interesting to consider if the goal of policymakers is to increase total participation of the couple.

Losing the ability to perform an activity of daily living yields on average a 4.9 (6.2) percentage point decline in the participation probability of husbands (wives). Similarly, important negative effects arise from a deterioration of one's subjective health status and appear to have long-lasting additional effects for husbands while this lagged effect is not found for wives. When considering dynamics, the long-term effect of a one-time change in health status is estimated to be 5.0 and 4.9 percentage points for husbands and wives respectively compared to 3.2 and 2.5 percentage point for contemporaneous impacts. Finally, the cross-spouse income effect is moderate for wife and result in an estimated one percentage point increase in their probability of participation for a deterioration in subjective health status of their husband.

Husbands' are found to have a positive incentive to work when their wife is entitled to the spouse allowance on their account. Although this effect is important it does not balance out the negative effect on participation of the wife. Therefore there is a net negative participation effect of the spouse allowance on participation of the couple.From a policy perspective, the spouse allowance effects are not negligible and are statistically significant although they offset partially each other in the case of the husband's account. Therefore, it is not clear if the spouse allowance results in lower aggregate participation at the couple's level. As a matter of fact, without exogenous variation in the spouse benefit it is difficult to predicts the effect of potential reforms. In Figure 2, a simulation exercise is performed where spouse allowance parameters are set to zero and compared with baseline predicted and observed transition rates.

[FIGURE 2 ABOUT HERE]

Compared to baseline hazard rates out of the labour force, the spouse allowance appears to a positive incentive for husbands at precisely age 64 while it gives a negative incentive for wives at age 62 which is roughly reflection the average age difference being 1.7 years in the sample. This is indirect evidence that the spouse allowance can be part of the explanation for joint transitions out of the labour force.

6.2.5 Goodness-of-Fit

Upon estimating all these different models, it is important to assess to which extent they can fit the observed sequences mentioned in table 2. Such an exercise is performed by simulating a number of times, sequences of participation based on observed characteristics in the sample of couples at hand, over draws from the estimated error distribution of the participation sequence.

I do this for two models. First, the static bivariate model is used and not the univariate static models since we saw that parameter estimates are the same and that correlation restrictions were rejected by a likelihood ratio test. The competing model is the general bivariate dynamic probit since we saw that restrictions from the univariate dynamic case were similarly rejected and that cross-spouse dependence is statistically significant. Hence, the difference between the two models arises from the inclusion of dynamics in participation and in health/insurance dynamics in the dynamic model. Table 7 reproduces the observed sequences from table 2 for comparison along with the average simulated frequencies based on 1,000 simulations from the estimated parametric error distribution. Sequences are grouped by the number of transitions involved to facilitate interpretation.

[TABLE 7 ABOUT HERE]

The dynamic and static model fit rather well the sequences with no transitions as both high unobserved heterogeneity in the static case and high state dependence are flexible enough to accommodate these patterns. Not surprisingly, note however that in each case (participation and non-participation) the combination between unobserved heterogeneity and SD in the dynamic model always performs better than the static model although these estimates are not adjusted for parameter uncertainty.

For sequences involving a single transition towards participation or to non-participation, things get more difficult to handle for the static model which cannot accommodate the high unexplained component to participate on one hand with the high unexplained component once the spouse does not participate. Hence, the SD framework enables to incorporate such "bunching" behavior of participation and non-participation far better except for the 10000 sequence for wives. Furthermore, when looking at more complex transition patterns it is often striking to see how well the dynamic model fits these transitions for both husbands and wives and outperforms the static model.

In order to get an informal global assessment of the fit of both models, we can compute the Pearson goodness-of-fit statistic for the observed and predicted frequencies.[17] Table 8 reports such statistics for both models and for both husbands and wives.

[TABLE 8 ABOUT HERE]

Results reported in table 8 show that the equality of predicted and observed sequences for the dynamic model cannot be rejected for wives at 5% while it is not rejected only at the 1% level for husbands. However, this equality is clearly rejected for the static model. Therefore, this confirms the informal observation made previously about the fit of both models. It is not however a formal test since it does not account for parameter uncertainty due to estimation.

7 Conclusion

In reforming the social security system, one cornerstone should be that it can adequately meet the needs of a changing generation of elderly who have much more labour market experience and therefore stimulate their participation at older age if the ageing problem threatens public finance. Since the positive participation trend across cohorts of women is an important ingredient to successfully cope with the financial problems generated by the ageing problem it is important that these are not impeded by possibly outdated social security measures which dealt efficiently with couples of the preceding generation but potentially have now adverse effects on the behavior on the current generation of elderly.

[17]For actual frequencies n_s and predicted $\widehat{n}_s$ of the (2^2) 32 sequences $(s = 1, ..., 32)$ $GOF = \sum_{s=1}^{32} \left(\frac{n_s - \widehat{n}_s}{\sqrt{\widehat{n}_s}}\right)^2$ which follows an asymptotic Chi-Square distribution with $S-1$ degrees of freedom if we neglect parameter uncertainty.

In this respect, this paper tried to identify the complex dynamics of joint labour force of older couples in the United States using the most up to date source of data on the behavior of the elderly (HRS) and a flexible reduced-form framework that would place few restrictions on the richness of those potential dynamics. Moreover, it had a second objective of looking at the incentive effects of the spouse allowance. A few key results are worth summarizing and may add to our understanding of joint labour supply dynamics of older couples.

When accounting for dynamics, it appears that participation of couples is importantly governed by state-dependence which leads in reality to bunching of participation and non-participation episodes in adjacent periods. Similar to Blau (1997), pension accruals appear to have a stronger effect on the wife's participation decision than on the husband. Where does this gender difference come from is still an open question. Nevertheless, the effects are important enough to induce considerable transitions out of employment on the 55-60 age segment. Indeed, coupled with the dependence of a spouse's decision on the state the other spouse occupied in an adjacent period this can also have indirect effects for husbands and wives if complementarity in leisure is present. Hence, the cross-spouse SD results coupled with the correlation in transitory error indicate that there are channelling mechanisms through which these indirect effects can manifest themselves which was a similar conclusion reached by Blau (1998).

Finally, the spouse allowance is found to have a statistically significant effect on participation of the couple as predicted by Blau (1997). However, this study is the first to assess if it is statistically different from zero. The participation effects do not cancel each other and the empirical evidence suggest that the overall effect of the program on participation of couples is negative. Furthermore, these effects appear to be much stronger at age 62 for wives and age 64 for husbands which is exactly the average age difference for couples in the sample.

References

[1] Baker, M. (2002): "The Retirement Behavior of Married Couples: Evidence from the Spouse Allowance", *Journal of Human Resources* 37:1, pp. 1-34.

[2] Blau, D.M. (1997): "Social Security and Labour Supply of Older Married Couples" *Labour Economics* 4, pp. 373-418.

[3] Blau, D.M. (1998): "Labor Force Dynamics of Older Married Couples" *Journal of Labor Economics* 16:3, pp. 595-629.

[4] Burtless, G. (1990): "Comment: The Joint Retirement Decision of Husbands and Wives", in *Issues in the Economics of Aging*, eds. D.A. Wise, Chicago University Press, pp. 255-7.

[5] Chamberlain, G. (1984): "Panel Data", in *Handbook of Econometrics*, vol 2 chapter 22, eds Zvi Griliches and Michael D. Intriligator, Elsevier Science.

[6] Chay, K.Y. and D.R. Hyslop (2000): “Identification and Estimation of Dynamic Binary Response Panel Data Models: Empirical Evidence using Alternative Approaches”, Working Paper University of California Berkeley, 36 p.

[7] Christensen, B.J. and N. Datta Gupta (1994): “A Dynamic Programming Model of the Retirement Behavior of Married Couples”, CAE Working Paper #94-02, Cornell University, 42 p.

[8] Coile, C.C. (2003): “Retirement Incentives and Couples' Retirement Decisions”, NBER Working Paper 9496, Massachusetts, 34 p.

[9] Gruber, J. (1998): “Health Insurance and the Labor Market”, NBER Working Paper 6762, Massachussetts, 86 p.

[10] Gustman, A.L. and T.L. Steinmeier (2000): “Retirement in Dual Career Families: A Structural Model”, *Journal of Labor Economics* 18:2, pp. 503-545.

[11] Gustman, A.L. and T.L. Steinmeier (2002): “Social Security, Pensions and Retirement Behavior Within the Family”, NBER Working Paper 8772, Massachusetts, February, 46 p.

[12] Hajivassiliou, V., McFadden, D. and P. Ruud (1996): “Simulation of Multivariate Normal Rectangle Probabilities and their Derivatives: Theoretical and Computational Results”, *Journal of Econometrics* 72, pp. 85-134.

[13] Heckman, J.J. (1981): “The Incidental Parameters Problem and the Problem of Initial Condition in Estimating a Discrete-Time Data Stochastic Process”, in *Structural Analysis of Discrete Data with Econometric Applications*, C.F. Manski and D. McFadden eds. , MIT Press, Cambridge, pp. 179-195.

[14] Hyslop, D.R. (1999): “State Dependence, Serial Correlation and Heterogeneity in Intertemporal labour Supply Participation of Married Women”, *Econometrica* 67:6, pp.1255-1294.

[15] Hurd, M.D (1990): “The Joint Retirement Decision of Husbands and Wives”, in Issues in the Economics of Aging, eds. D.A. Wise, Chicago University Press, pp. 231-254.

[16] Hurd, M.D. (1996): “The Effects of labour Market Rigidities on the labour Force Behavior of Older Workers”, in Advances in the Economics of Aging, eds by D.A. Wise, Chicago University Press, pp. 11-58.

[17] Jiménez-Martin, S., Labeaga, J.M. and M. Martinez Granado (1999): “Health Status and Retirement Decisions for Older European Couples”, IRISS Working Paper Series No. 1999-01, Luxembourg, 41 p.

[18] Lumsdaine, R.L. and O.L. Mitchell (1999): “New Developments in the Economic Analysis of Retirement”, in *Handbook of Labor Economics* vol 3 Chapter 49, Ashenfelter, O. and D. Card eds. Elsevier Science.

[19] Maestas, N. (2001): "Labor, Love and Leisure: Complementarity and the Timing of Retirement by Working Couples", mimeo Dept. of Economics, University of California Berkley, December, 61 p.

[20] McCarty, T.A. (1990): "The Effect of Social Security on Married Women's Labor Force Participation", *National Tax Journal* 43, pp.95-110.

[21] Peticolas, B. and T. Steinmeier (1999): "Health and Retirement Study Pension Value Database (Level 1): Data Description and Usage Version 1.0", July 15.

[22] Pozzebon, S. and O.S. Mitchell (1986): "Married Women's Retirement Behavior", *Journal of Population Economics* 2:1, pp. 39-53.

[23] Sédillot, B. and E. Walraet (2002): "La cessation d'activité au sein des couples: y-a-t-il interdépendance des choix?", Économie et Statistique No 357-58, pp. 80-102.

[24] Smith, J.P. (1999): "Healthy Bodies and Thick Wallets: The Dual Relation Between Health and Economic Status", *Journal of Economic Perspectives*, 13:2, pp. 145-166.

[25] Tamer, E. (2003): "Incomplete Simultaneous Discrete Response Model with Multiple Equilibria", *Review of Economic Studies* 70:1, 147-163.

[26] Train, K.E. (2002): *Discrete Choice Methods with Simulation,* Cambridge University Press, 321 p.

[27] Vella F. and M. Verbeek (1999): "Two-step estimation of panel data models with censored endogenous variables and selection bias", *Journal of Econometrics* 90:2, pp.239-263

[28] Vistnes, J.P. (1994): "An Empirical Analysis of Married Women's Retirement Decisions", *National Tax Journal* 48, pp.135-155.

Appendix A: Likelihood Contribution and GHK Simulator

First step is to look at $t > 2$. I normalize $Var(\eta_{mit}) = Var(\eta_{fit}) = 1$. Then looking at the serially correlated errors and assuming stationarity, their unconditional variance and covariance are given by $E(\varepsilon_{jit}^2) = \sigma_{vj}^2(1-\rho_j^2)^{-1}$ and $E(\varepsilon_{mit}\varepsilon_{fit}) = \rho_v(1-\rho_m\rho_f)^{-1}$. Then this implies that $\sigma_{\alpha j}^2 = 1 - \sigma_{vj}^2(1-\rho_j^2)^{-1}$ and corresponds to the share of unobserved heterogeneity in the total variance of the stochastic component η_{jit}. Note that if autocorrelation is positive then this share is smaller then if it is assumed to be zero.

The intertemporal covariances can be derived using the stationarity assumption in the same fashion,

$$\mathbf{E}(\eta_{jit}\eta_{jit-s}) = 1-\sigma_{vj}^2(1-\rho_j^s)(1-\rho_j^2)^{-1} \tag{15}$$

$$\mathbf{E}(\eta_{jit}\eta_{j'it-s}) = \rho_\alpha\left(\frac{1-\rho_m^2-\sigma_{vm}^2}{1-\rho_m^2}\right)^{1/2}\left(\frac{1-\rho_f^2-\sigma_{vf}^2}{1-\rho_f^2}\right)^{1/2} + \rho_j^s\rho_v(1-\rho_m\rho_f)^{-1}. \tag{16}$$

The initial conditions are added by augmenting this covariance matrix with the free correlations between period 1 and other periods. This correlation is restricted to be equal across time periods.

In building up the likelihood we need model the joint probability of the observed sequence of choices of the couple $h_i = (h_{mi1}, h_{fi1}, ..., h_{mit}, h_{fit}.., h_{miT}, h_{fiT})'$ given the parameters of the assumed data generating process and the observed characteristics. The loglikelihood is formed by the mean of the log of those probabilities, $\frac{1}{N}\sum_{i=1}^N \log\Pr(h_i|\theta)$ where θ denotes the vector of all parameters to be estimated. The integral in $\Pr(h_i|\theta)$ is a $2T$ dimensional integral and simulated using the GHK simulator also known as the smooth conditioning recursive (SRC) simulator.

This maximum simulated likelihood (MSL) which results from replacing probabilities by their simulated counterparts is an inconsistent estimator unless R goes to infinity. However, it is asymptotically normal and asymptotically equivalent to ML for $R/\sqrt{N} \to \infty$. I will report results for 50 Halton draws in estimation.[18] Standard errors of the marginal effects are computed from Monte Carlo replications.

[18] The results were not sensitive to doubling the number of draws.

Appendix B: Wage Profile Imputation and Social Security

In order to assess the role of social security, wage profiles for each spouse in the household are needed. As a matter of fact, wages are missing for two types of spouses in the data. A first case involves missing wages for workers while a second one involves missing wages of non-workers. In the first case, standard imputation techniques can be used using the panel data dimensions while in the second case one may have to assess the non-randomness of the sample of workers in order to use their information to impute wages for non-workers.

In the second case, the problem is complicated by the fact that the source of sample selection is not known a priori to come from either correlation in person-specific unobservables or from time-specific unobservables. Hence, I use the two-step estimator proposed by Vella and Verbeek (1999) to account for both selection processes. One advantage of this procedure is that a standard Wald Test is available to test for the presence of sample selection coming from both potential sources. In addition, this two-step approach allows dynamics in participation to affect the selection process and allows unknown form of heteroscedasticity and autocorrelation in the wage unobservable. I estimate the conditional wage for both spouse separately. From these estimates, I estimate a fixed effect for each spouse and then use this along with the cross-section information to impute wages for the two types of missing observations. In fact, this is a similar procedure to the approach taken by both Blau (1997,1998) and Gustman and Steinmeier (2000a,2002) with the major difference that selection is taken into account, both for unobservables varying in time and constant across time.

For each spouse we can model the reduced form labour supply choice as

$$
\begin{aligned}
w_{it}^* &= x_{it}'\beta + e_{it} && (17) \\
h_{it}^* &= z_{it}'\gamma + \phi h_{i,t-1} + u_{it} && (18)
\end{aligned}
$$

with the econometrician observing $w_{it} = \max(w_{it}^*, 0)$, $h_{it} = \mathbf{1}_{(0,\infty)}(h_{it}^*)$. Assume the two-component error structure $e_{it} = \mu_i + n_{it}$ and $u_{it} = a_i + v_{it}$ with

$$
\begin{aligned}
u_i = (u_{i1}, ..., u_{iT})|z_i &\sim IN(0, \sigma_a^2 \iota\iota' + \sigma_v^2 I) && (19) \\
\mathbf{E}(e_{it}|x_{it}, z_{it}, u_i) &= \tau_1 u_{it} + \tau_2 \overline{u}_i && (20)
\end{aligned}
$$

where $\overline{u}_i = T_{t=1}^{-1\,T} u_{it}$.This is the case analyzed by Vella and Verbeek (1999) which allows for heteroscedasticity and autocorrelation. Conditioning on the whole sequence $h_i = (h_{i2}, ..., h_{iT})'$ and the initial state h_{i1} then

$$
\mathbf{E}\left(w_{it}|x_i, z_i, h_{i1}, h_i\right) = x_{it}'\beta + \mathbf{E}(e_{it}|x_{it}, z_{it}, h_{i1}, h_i). \tag{21}
$$

Expanding the second R.H.S. component using (20) yields,

$$
\mathbf{E}(e_{it}|x_{it}, z_{it}, h_{i1}, h_i) = \tau_1 \mathbf{E}\left(u_{it}|x_{it}, z_{it}, h_{i1}, h_i\right) + \tau_2 \mathbf{E}\left(u_i|x_{it}, z_{it}, h_{i1}, h_i\right) \tag{22}
$$

Then given consistent parameters estimates of $\theta = (\gamma_1, \pi_1, \gamma, \sigma_a, \phi)$ from the first step dynamic probit, then Vella and Verbeek show that one can get an unbiased estimator of $\mathbf{E}\left(u_{it}|x_{it}, z_{it}, h_{i1}, h_i\right)$ given by

$$\widetilde{u}_{it} = \frac{1}{f\left(h_{i1}, h_i|x_{it}, z_{it}; \widehat{\theta}\right)} \frac{1}{R}\sum_{r=1}^{R}\left[\left(\widetilde{a}_{ir} + v_{it}^{G}(\widetilde{a}_{ir}; \widehat{\theta})\right) f\left(h_{i1}, h_i|x_{it}, z_{it}, \widetilde{a}_{ir}; \widehat{\theta}\right)\right]$$

where $\widetilde{a}_{ir}$ are draws from $f(a)$ given $\widehat{\sigma}_a$ and $v_{it}^{G}(\widetilde{a}_{ir}; \widehat{\theta})$ is the generalized residual of the first step binary choice model Then, I estimates (17) by OLS including as regressors $\widetilde{u}_{it}$ and $T_{t=1}^{-1}\ \widetilde{u}_{it}$ as regressors and using only workers who declare wages. From the coefficient estimates $\widehat{\beta}$, I estimates the fixed effects from the observed wages for each spouse with some wage data. x_{it} is allowed to be quadratic in age, in total market experience, in tenure on the current job, on industry and census region dummies and on schooling and race. Time dummies are also included. z_{it} includes the standard quadratic in age as well as the number of children, capital income and health which consist the exclusion restrictions. Note that state-dependence acts as an exclusion restriction also. Results of the second-step are reported in Table B.1

Wage Equation Estimates (Log Hourly Wage)

Covariates	Parameter estimates			
	Male		Female	
x	β_m	se	β_f	se
Intercept	−0.354	1.069	1.550	0.608
Age	0.073	0.038	0.007	0.022
Age^2/10	−0.007	0.003	−0.002	0.002
Tenure	0.026	0.004	0.028	0.004
Tenure^2/10	-0.003	−0.001	−0.005	0.001
Experience	0.014	0.011	0.016	0.005
Experience^2/10	−0.002	0.002	−0.002	0.001
Primary School Years	0.040	0.030	0.006	0.029
High School Years	0.058	0.011	0.044	0.010
College + Years	0.120	0.009	0.112	0.007
τ_1 (time spec. selection)	0.190	0.047	0.151	0.037
τ_2 (person spec. selection)	0.320	0.052	0.237	0.041
Est. Variance of Fixed E	0.35		0.22	
Correlation $(\widehat{w}, w)$	0.83		0.85	

Census Region, Industry and Time dummies included.

— Table B.1 —

The main component of a spouse's benefit at age a is the averaged monthly wage which consist of the 35 highest indexed monthly wage or if fewer years are available then the five worst wages are ignored and the remaining ones averaged. A detailed calculation of the AME requires both the wage profile of the spouse and the distribution of wages of other workers as the AME is indexed according to the evolution of the mean of the distribution. This information is available only in the restricted data set which I cannot use. Therefore, I resort to using the mean of observed wages as an "hopefully" unbiased estimate of the AME.

The AME is used to compute the Primary Insurance Amount (PIA). The PIA is a piece-wise linear function of the AME. Consider t as the time of retirement. The 1995 function was

$$\begin{aligned} PIA_t &= c_1 \min[AME_t, p_1] + c_2 \min[\max[AME_t - p_1, 0], p_2 - p_1] \\ &\quad + c_3 \max[AME_t - p_1 - p_2, 0]. \end{aligned} \tag{23}$$

where $p_1 = \$426$ and $p_2 = \$2567$, referred to as bendpoints, and $(c_1, c_2, c_3) = (0.4, 0.32, 0.15)$ in 1995. Once the PIA is computed, some adjustments are made for the age at which benefits are taken. Refer to a_t as a spouse's age at period t. This yields the spouse's own entitlement b_t given by

$$b_t = 1_{[62,\infty)}(a_t) \exp\left(g_{DRC} y_{DRC} - g_{ARF} y_{ARF}\right) PIA_t \tag{24}$$

where y_{DRC} is the number of years at t since the spouse turned 65 up to a maximum of 5 if the Normal Retirement Age is 65 and y_{ARF} is the number of years at t before the individual reaches 65 if he/she is older than or 62. g_{DRC} is the yearly rate at which benefits are increased for delayed retirement (Delayed Retirement Credit) and g_{ARF} is the actuarial reduction factor which decreases benefits to reflect increased. These along with the normal retirement age have been changed as a result of the 1983 amendments and depend on the birth year of the spouse. The adjustment where made according to the information published in the *Handbook of Social Security*, Chapter 7.

Table 1 *Transition of Spouses*

		State at (t-1)			
		Husbands		Wives	
Year	State	N	L	N	L
1994	N	84.7	13.3	87.9	13.0
	L	15.3	86.7	12.1	87.0
1996	N	85.7	14.6	89.6	17.8
	L	14.3	85.4	10.4	82.2
1998	N	89.4	16.7	88.9	18.4
	L	10.6	83.3	11.1	81.6
2000	N	91.4	20.3	92.4	19.6
	L	8.6	79.7	7.6	80.4

Conditional Prob of leaving state at t
N = non-participation, L = participation.

Table 2. *Participation Sequences HRS 1992-2000*

Sequences	Husb.	Wives	Sequences	Husb.	Wives
No Trans.			**3-Trans.**		
11111	1170	942	00101	3	3
00000	501	800	10010	11	5
	1671	1742	11010	24	27
1-Trans.			10100	22	10
Δ^- LFP			01011	2	5
11110	261	187	01101	4	3
11100	200	171	01001	2	4
11000	192	177	10110	17	7
10000	182	161		85	64
	835	696	**4-Trans.**		
Δ^+ LFP			10101	6	5
01111	45	53	01010	2	6
00111	18	32		8	11
00011	5	23			
00001	12	18			
	80	126			
2-Trans.					
11101	55	50			
11011	46	49			
10111	43	29			
10011	12	14			
11001	17	20			
10001	8	11			
01000	16	23			
00100	10	23			
00010	8	22			
01100	15	22			
00110	4	13			
01110	15	13			
	249	276			

Table 3 *Dependence in Transitions*

State of Other Spouse	(t-1)	Husbands N	Husbands L	Wives N	Wives L
		State at (t)			
1994	N	39.0	61.0	55.9	44.1
	L	24.0	76.0	35.6	64.4
		Δ(Pr)	15.0	Δ(Pr)	20.3
1996	N	46.4	53.6	63.0	37.0
	L	28.2	71.8	39.8	60.2
		Δ(Pr)	18.2	Δ(Pr)	23.2
1998	N	54.2	45.8	65.3	34.7
	L	32.3	67.7	43.5	56.5
		Δ(Pr)	21.9	Δ(Pr)	21.8
2000	N	61.0	39.5	70.9	29.1
	L	39.5	60.5	46.6	53.4
		Δ(Pr)	21.0	Δ(Pr)	24.3

Cells: Conditional Prob of leaving state at t

Table 4 *Joint Transitions of Couples*

State at t	State at (t-1) LL	LN	NL	NN
LL	74.8	11.2	12.6	1.7
LN	11.3	69.3	2.1	7.8
NL	10.0	1.6	64.5	5.2
NN	3.9	18.0	20.8	85.3

Cells: % of Column Frequencies

Table 6 *Marginal Effect Estimates*

	Estimates: (1,1) state at ($t-1$)					
		Husband			Wife	
Covariates	Mean	Dynamic	Static	Mean	Dynamic	Static
Age	61.6	**-0.016**	**-0.035**	57.7	**-0.010**	**-0.019**
ADL index (t)	0.15	**-0.049**	**-0.056**	0.15	**-0.062**	**-0.054**
ADL index ($t-1$)	-	-0.005	-	-	-0.018	-
Pension ac. 55-60	0.65	**0.018**	**0.047**	0.67	**0.069**	**0.196**
Pension ac. 60-65	0.19	-0.008	0.007	0.34	**0.033**	**0.074**
Health index (m, t)	2.61	**-0.032**	**-0.038**	2.61	**0.010**	**0.007**
Health index ($m, t-1$)	2.53	**-0.018**	-	2.53	-0.001	-
Health index (f, t)	2.53	0.006	0.003	2.53	**-0.025**	**-0.027**
Health index ($f, t-1$)	2.46	0.001	-	2.46	**-0.014**	-
Age difference ($m-f$)	1.73	**0.002**	**0.005**	1.73	**-0.003**	**-0.006**
Spouse A. (on m's acc.)	0.09	**0.156**	0.020	0.09	**-0.362**	**-0.377**
Spouse A. (on f's acc.)	0.10	**-0.381**	0.122	0.10	0.092	-0.117
Participation Prob (.)						
$(h_{mt-1}, h_{ft-1}) = (1,1)$		**0.836**	**0.588**		**0.814**	**0.508**
$(h_{mt-1}, h_{ft-1}) = (1,0)$		**0.772**	-		**0.178**	-
$(h_{mt-1}, h_{ft-1}) = (0,1)$		**0.213**	-		**0.731**	-
$(h_{mt-1}, h_{ft-1}) = (0,0)$		**0.148**	-		**0.110**	-
Est. SD Effects						
SD husband		**0.623**				
SD wife		**0.636**				
Cross-SD (wife for husb. LFP)		**0.064***				
Cross-SD (husb. for wife LFP)		**0.083**				

Notes: 10,000 Monte Carlo replications are used using table 5 estimates
to compute standard errors. Evaluated at average characteristics.
Estimates in bold statistically significant at 5% level or less. * significant at 6.3%

Table 5 *Joint Labor Supply Estimates*

	Univariate Static		Bivariate Static		Univariate Dynamic		Bivariate Dynamic	
Covariates	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife
Age	**-0.105**	**-0.069**	**-0.106**	**-0.069**	**-0.077**	**-0.051**	**-0.074**	**-0.045**
Race (Black=1)	**-0.136**	**0.234**	**-0.132**	**0.222**	-0.035	**0.211**	-0.052	**0.215**
Schooling (yrs)	**0.024**	**0.020**	**0.023**	**0.021**	**0.020**	0.002	**0.020**	0.003
Nb marriage	**-0.096**	0.009	**-0.091**	0.007	-0.026	0.024	-0.027	0.030
ADL index (t)	**-0.190**	**-0.204**	**-0.188**	**-0.202**	**-0.227**	**-0.266**	**-0.225**	**-0.262**
ADL index ($t-1$)	-	-	-	-	-0.022	-0.079	-0.026	-0.078
Pension ac. 55-60	**0.142**	**0.735**	**0.156**	**0.712**	**0.079**	**0.288**	**0.083**	**0.291**
Pension ac. 60-65	0.029	**0.239**	0.023	**0.201**	-0.040	**0.126**	-0.041	**0.135**
Health index (m, t)	**-0.129**	**0.021**	**-0.129**	**0.027**	**-0.147**	0.035	**-0.148**	**0.039**
Health index ($m, t-1$)	-	-	-	-	**-0.081**	-0.012	**-0.084**	-0.001
Health index (f, t)	0.002	**-0.095**	0.011	**-0.095**	0.026	**-0.101**	0.030	**-0.104**
Health index ($f, t-1$)	-	-	-	-	-0.001	**-0.060**	0.006	**-0.062**
Capital income ('000000)	**0.008**	0.002	**0.010**	0.002	**0.017**	0.001	**0.017**	0.001
Age difference ($m-f$)	**0.020**	**-0.023**	**0.019**	**-0.022**	**0.013**	**-0.015**	**0.011**	**-0.011**
Spouse A. (on m's acc.)	0.373	**-1.399**	0.083	**-1.353**	0.572	**-1.458**	**0.718**	**-1.527**
Spouse A. (on f's acc.)	0.272	-0.333	0.414	-0.488	**-1.759**	0.476	**-1.739**	0.395
Birth Year (/100)	0.161	0.061	-0.260	-0.013	0.537	**1.412**	0.611	1.303
Participation husb. ($t-1$)	-	-	-	-	**1.421**	-	**1.465**	**0.162**
Participation wife ($t-1$)	-	-	-	-	-	**1.311**	**0.118***	**1.562**
Participation ($t-1$)×age	-	-	-	-	0.016	0.055	-	-
$\%(\sigma^2_{\alpha j})$	**0.737**	**0.775**	**0.736**	**0.771**	**0.303**	**0.290**	**0.328**	**0.320**
$AR(1): \rho_j$	-	-	-	-	**-0.262**	**-0.281**	**-0.254**	**-0.288**
ρ_α	-		**0.255**		-		0.217	
ρ_v	-		**0.280**		-		**0.162**	
LogL (Average)	-2.02	-2.11	-4.101		-1.872	-1.948	-3.788	

Constant included. N= 2928, T=5, R=50. (BFGS Algorithm)

Table 7 *Predicted and Observed Participation Sequences*

	Husbands			Wives		
Sequences	Obs.	B.Dyn	Static	Obs.	B.Dyn	Static
No transitions						
11111	1170	1170.3	1147.8	942	947.8	914.1
00000	501	456.3	453.4	800	748.6	742.3
1-Transition						
Δ^- *LFP*						
11110	261	253.2	236.9	187	190.7	160.5
11100	200	212.8	141.6	171	172.6	105.5
11000	192	209.0	122.4	177	190.7	90.9
10000	182	185.1	154.8	161	175.7	162.3
Δ^+ *LFP*						
01111	45	35.5	7.9	53	48.8	16.9
00111	18	23.6	2.1	32	37.8	4.7
00011	5	14.3	2.0	23	26.5	3.7
00001	12	18.0	6.7	18	34.6	15.7
2-Transitions						
11101	55	58.2	113.4	50	46.8	94.9
11011	46	40.3	50.1	49	34.9	51.3
10111	43	32.2	19.9	29	29.2	26.7
10011	12	10.4	7.1	14	10.0	10.6
11001	17	19.6	34.4	20	16.5	32.0
10001	8	11.3	13.1	11	13.1	19.3
01000	16	24.2	77.8	23	32.9	91.0
00100	10	21.5	33.8	23	29.9	50.6
00010	8	15.8	15.6	22	25.2	27.8
01100	15	13.2	30.3	22	13.4	32.2
00110	4	10.7	8.3	13	13.2	11.2
01110	15	13.3	14.3	13	14.9	17.3

7 (continued)	Husbands			Wives		
	Obs	B.dyn.	Static	Obs	B.dyn	Static
3-Transitions						
00101	3	2.9	2.6	3	5.0	7.1
10010	11	9.0	28.9	5	7.3	31.3
11010	24	24.2	64.8	27	19.2	55.9
10100	22	19.8	55.3	10	16.9	57.7
01011	2	2.4	3.5	5	4.0	7.0
01101	4	2.3	8.9	3	3.0	11.3
01001	2	1.6	7.0	4	2.3	10.3
10110	17	11.0	33.2	7	8.3	28.6
4-Transitions						
10101	6	3.6	17.2	5	3.7	17.9
01010	2	2.5	12.9	6	3.4	19.4

1000 Monte Carlo replications used and freq averaged.

Table 8 χ^2 *Goodness of Fit Test*

	Dynamic	Static
All Sequences		
Husbands	49.5	618.8
Wives	45.3	695.2

$\chi^2_{32.0.95} = 45.91, \chi^2_{32.0.99} = 55.67$

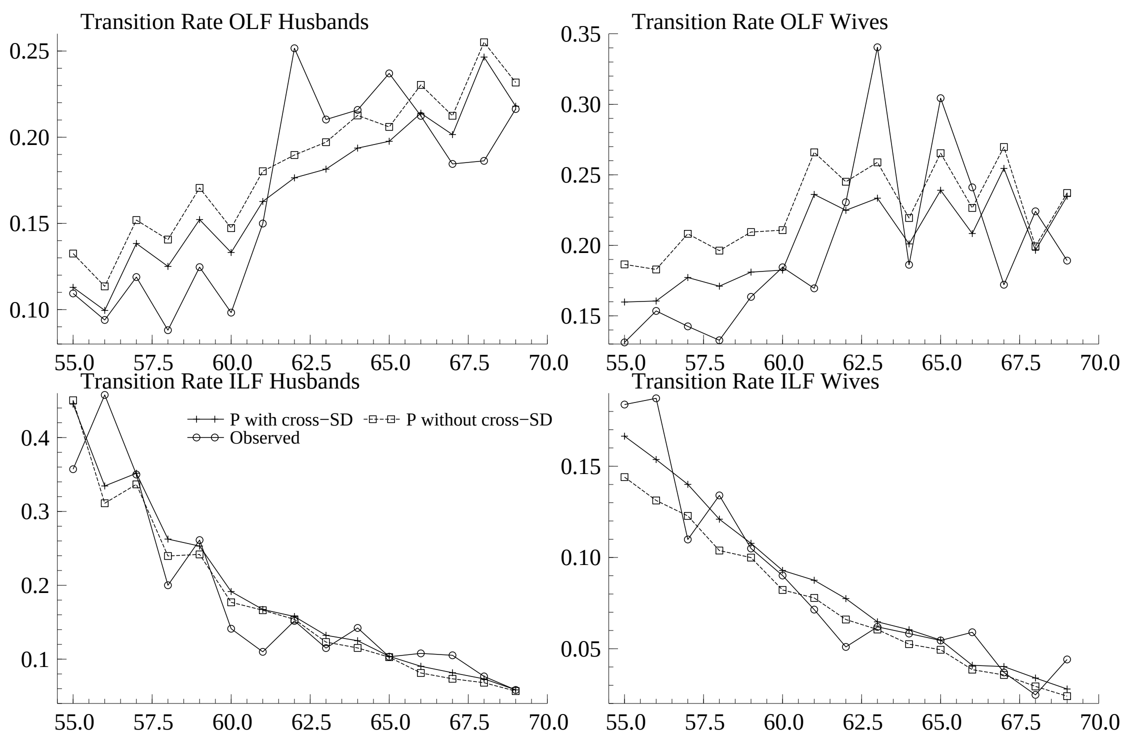

Figure 1: Comparisons of Transitions Rates with and without Cross State-dependence.

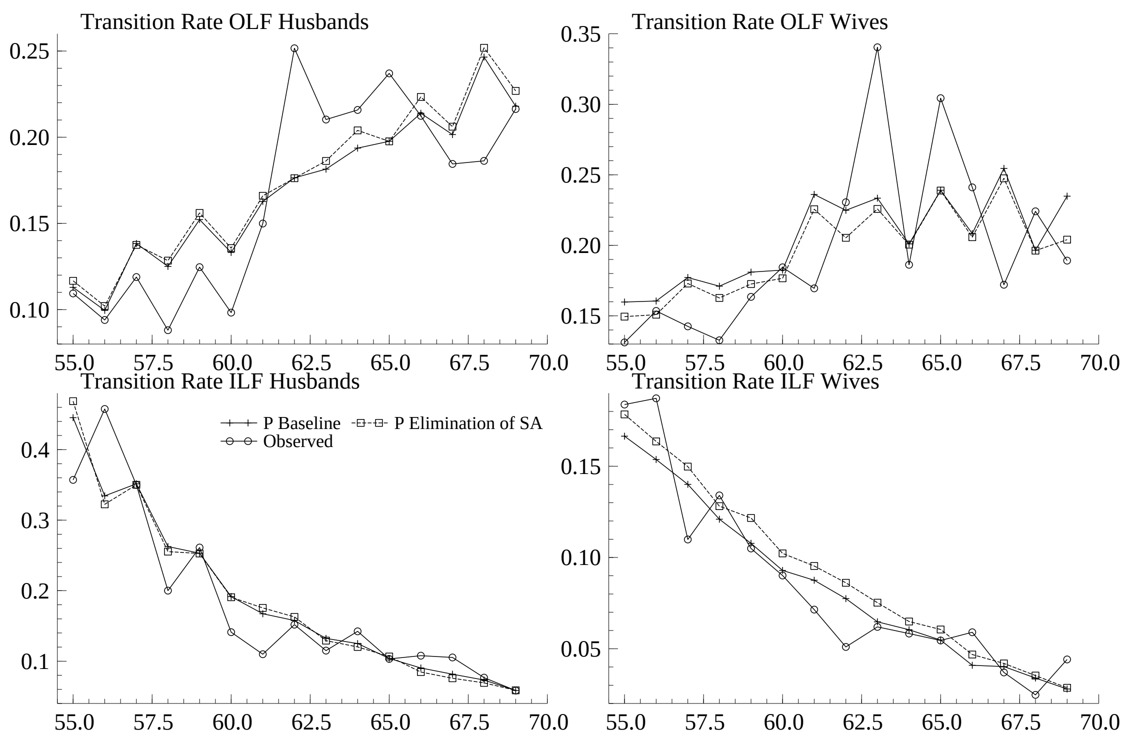

Figure 2: Simulated Effect of the Elimination of the Spouse Allowance

IZA Discussion Papers

No.	Author(s)	Title	Area	Date
818	J. Pencavel	The Surprising Retreat of Union Britain	3	07/03
819	M. Beine F. Docquier H. Rapoport	Brain Drain and LDCs' Growth: Winners and Losers	1	07/03
820	C. M. Cornwell K. H. Lee D. B. Mustard	The Effects of Merit-Based Financial Aid on Course Enrollment, Withdrawal and Completion in College	6	07/03
821	P. Carneiro J. J. Heckman	Human Capital Policy	6	07/03
822	D. Weichselbaumer R. Winter-Ebmer	The Effects of Competition and Equal Treatment Laws on the Gender Wage Differential	6	07/03
823	A. Filippin	Discrimination and Workers' Expectations	5	07/03
824	A. Filippin	Discrimination and Workers' Expectations: Experimental Evidence	5	07/03
825	A. Filippin A. Ichino	Gender Wage Gap in Expectations and Realizations	5	07/03
826	K. T. Hansen J. J. Heckman K. J. Mullen	The Effect of Schooling and Ability on Achievement Test Scores	6	07/03
827	H. Buddelmeyer E. Skoufias	An Evaluation of the Performance of Regression Discontinuity Design on PROGRESA	6	07/03
828	D. Checchi T. Jappelli	School Choice and Quality	3	07/03
829	J. J. Heckman X. Li	Selection Bias, Comparative Advantage and Heterogeneous Returns to Education: Evidence from China in 2000	6	07/03
830	T. J. Hatton	Emigration from the UK, 1870-1913 and 1950-1998	1	07/03
831	J. H. Abbring G. J. van den Berg	Analyzing the Effect of Dynamically Assigned Treatments Using Duration Models, Binary Treatment Models, and Panel Data Models	6	07/03
832	P.-C. Michaud	Joint Labour Supply Dynamics of Older Couples	3	07/03

An updated list of IZA Discussion Papers is available on the center's homepage www.iza.org.