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Abstract

An empirical analysis of labor market transitions for spouses in couples is implemented. Object of study are transitions between the states of nonparticipation, unemployed search, and employment. Motivated by a model of household search, the emphasis is on spousal variables and interactions. Additionally, a proxy for the business cycle is included in the analysis, and household specific unobserved heterogeneity is accounted for. Results show that female transitions into nonparticipation (both out of unemployed search and employment) are positively affected by the husband's income (while no effect is found for transitions out of nonparticipation). Men seem to move from employment into unemployed search easier the higher is the wife's income. Since the wife having an income is in turn strongly accociated with female participation, this suggests that households with a participating wife are better able to deal with unemployment of the husband. A supplementary analysis with reservation wages and numbers of applications points in the same direction. Husbands' reservation wages are only sensitive to his own unemployment income if the wife is nonparticipating. This implies that unemployment benefits have a different role in households with the husband as a sole earner compared to dual earner households.

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1 Introduction

This study empirically analyzes spousal interactions in labor market transition rates between the states of nonparticipation, unemployed search, and employment. The approach is empirical and without the aim of a priori imposing a theoterical structure, but the underlying theoretical motivation can be found in the household search model. Additional outcomes studied are reservation wages and search effort. We start by sketching the wider context in which the household search model is relevant.

Female labor force participation has increased rapidly over the past few decades. In recent years, the gender gap in labor force participation does not narrow any further while a subtantial gap persists. In the literature, it was increasingly recognized that labor supply of women is best studied in the context of joint decisions of couples. Most models of labor supply consider the labor market *states* of couple members as outcomes, rather than looking at the dynamics. Also the implications of policy measures, such as tax credits, are mostly evaluated in terms of labor market states, ignoring that transitions into and out of employment may be affected differentially. For policy makers it is important to gain insight in what makes women move from out of (into) nonparticipation into (out of) search or employment. Women that easily move belong to the participation margin. The macroeconomic literature recognized the importance of the participation margin for fluctuations in the labor market, especially in relation to the cycle (Elsby, Hobijn, and Sahin, 2015).

The underlying theoretical motivation of the present analysis is the household search model, first introduced by Burdett and Mortensen (1978), which after this first introduction remained untouched for quite a while. Theoretical expositions of the household search model reveal the implications of household search for the reservation wage of unemployed searchers. Guler, Guvenen, and Violante (2012) explore the properties of the household search model. Structural estimates of the household search model are provided by Dey and Flinn (2008) and Flabbi and Mabli (2018).

The aim of the present analysis is to shed more light on the labor market transitions of couple members, without imposing the structure of the model, but using it as a guideline. We distinguish three states at the individual level: nonparticipation, unemployed search,

and employment. The data allow the observation of transitions at the monthly level and each of the three labor market states will be used both as state of origin and as state of destination, providing insight in the labor market dynamics of couple members and the interaction between them.

The original household search model by Burdett and Mortensen (1978) explicitly includes the choice of search effort, and the extensive margin of this is the choice to participate or not. Since this model both covers the decision to participate or not, explains the role of spousal drivers for transitions, and incorporates the household dimension, it is a suitable underlying framework for studying the labor market transitions of couple members. The model has several implications. The reservation wage of an individual potentially depends on the partner's income in ways explained later. Unemployment of the partner may induce someone to search and participate, while an accepted job offer of the partner may lead to a job quit.

But heterogeneity across households in an empirical implementation brings in additional spousal interactions. For instance, partners may share preferences for consumption and there may be complementarities in leisure, such that employment of one partner goes together with employment of the other. These are mechanisms not present in the structural estimations by Dey and Flinn (2008) and Flabbi and Mabli (2018), since the nature of their estimation method (by the method of simulated moments) gives limited scope to allow for observed or unobserved heterogeneity. We thus use a joint transition model for the labor market transitions of both spouses at the monthly level, using panel data to allow for couple specific unobserved heterogeneity. Transitions depend on the spouse's labor market state and spousal income.

Data are from the OSA labor supply panel for the periods 1986-2014.[1] The OSA is a biannual survey at the household level allowing construction of labor market histories and transitions at the monthly level. The long time period of the survey facilitates pooling of information over waves to increase observations, but also introduces additional issues to address. The structural household search model imposes a stationary environment. Stationarity is clearly not satisfied for the period of the sample. The empirical model needs

[1]Sociaal Cultureel Planbureau (2016)

to include long term trends, cyclical effects, and maybe cohort effects. To proxy for the labor market cycle, we include the vacancy rate. In the macroeconomic literature there is an interesting discussion on how the labor market cycle affects flows between nonparticipation and unemployment and the search effort (see e.g. the discussion in R. Shimer, 2012).

While in many applications, especially in the field of labor supply, the states of nonparticipation and unemployed search are either merged or sample selection rules exclude nonparticipants as much as possible, Jones and Riddell (1999; 2006) emphasized the importance of making a distinction between the states of nonparticipation and unemployed search.

Issues in the literature that are related to the household search model are the added worker effect (introduced by Lundberg, 1985) and household labor supply responses to earnings risk (Attanasio, Low, and Sánchez-Marcos, 2005; Blundell, Pistaferri, and Saporta-Eksten, 2016; Pruitt and Turner, 2020). Mankart and Oikonomou (2017) and Wang (2019) extend the household search model to allow for a stochastic process representing business cycle fluctuations to study risk sharing, while Pilossoph and Wee (2019) use the household search model to explain the marital wage premium.

In presenting results we focus on different dimensions: spousal interactions in labor market transitions, reservation wages and search effort, cyclical effects on transitions and labor markets states, and the historical trend effects.

Descriptive results already show the increasing importance of women's incomes to facilitate the unemployment of men within households. Estimation results suggest that unemployed men transit into employment at a lower rate the higher is the wife's income, while employed men transit into employment at a higher rate the higher the wife's income. This finding is supported by a positive effect of the wife's income on the husband's reservation wage (for a selective sample of searching men). The result for transitions, however, is not robust with respect to the inclusion of unobserved heterogeneity. The estimates of the heterogeneity specification suggest that there are two groups of men: a large group with low transitions rates and a small group that transits more frequently in either direction of employment. For this latter group the effect of spousal income applies.

Women transit more easily into nonparticipation the higher is the spousal income. Re-

markable is that we do not find an effect of spousal income on the transition of women out of nonparticipation. A pattern that is consistent with a husband climbing the career ladder and the wife leaving the labor force once a certain income level has been reached. For policy makers the implication seems to be that it is more important to focus on measures aimed at preventing women from leaving the labor force than aimed at inducing to re-enter.

Overall, women's labor market states seem to fluctuate more with the vacancy rate, and notably the transition out of unemployed search into employment is more sensitive to the business cycle for women than for men.

Section 2 provides theoretical background based on the household search model. Section 3 presents the data including descriptives. Section 4 includes the empirical methodology. Section 5 presents the results. Section 6 concludes.

2 Background: a model of household search

This section sketches a model of household search to provide the theoretical background. The exposition is based on models appearing in the literature (Burdett and Mortensen, 1978; Guler, Guvenen, and Violante, 2012) with details adjusted to match it to our purpose. There is an intratemporal household utility function $u(y_m, y_f)$,[2] depending on income of the husband y_m and the wife y_f, with $y_j = b_j$ $(j = m, f)$ if spouse j is not in employment. Instantaneous cost of search for a husband with search effort s_m and a wife with search effort s_f is given by $c(s_m, s_f)$ with $s_j \geq 0, j = m, f$.[3] Typical regularity conditions include $c(0, 0) = 0$, $\partial c(s_m, s_f)/\partial s_j > 0, j = m, f$. Moreoever, for a unique solution of the optimal search effort, additional conditions like concavity are usually imposed. Jobs arrive with job offer arrival rate $\lambda_{uj}(s_j), j = m, f$[4] for nonemployed individuals and by $\lambda_{ej}(s_j), j = m, f$ for employed individuals. A common assumption is that $\lambda'_{lj}(s_j) > 0; l = e, u; j = m, f$. On the job there can be exogenous layoff according to rate $\delta_j, j = m, f$.

V_{uu} denotes the value function of a household where both spouses are nonemployed. The

[2] More specific, utility can be specified as a function of household income $y_m + y_f$.

[3] Burdett and Mortensen (1978) define search effort in terms of time devoted to search that competes with labor time and leisure time, and the cost of search are the utility cost of leisure forgone.

[4] Such that for nonpartipants the arrival rate equals $\lambda_{uj}(0)$, which is not necessarily zero.

choice of nonparticipation is incorporated in this value function, since nonparticipation is defined as the situation in which $s_j = 0$ while unemployed search is the case where $s_j > 0$. Jobs are characterized by wages drawn from wage offer distribution $F_j(.), j = m, f$. The value function of spouse m being employed and spouse f not is indicated by $W_{eu}(w_m)$ with w_m the prevailing wage (earnings). Likewise $W_{ue}(w_f)$ is defined. In a continuous time sequential search framework the value V_{uu} becomes

$$\begin{aligned} \rho V_{uu} = u(b_m, b_f) - c(s_m^*, s_f^*) + \lambda_{um}(s_m^*) \int_{R_{um}} [W_{eu}(x) - V_{uu}]\, dF_m(x) \\ + \lambda_{uf}(s_f^*) \int_{R_{uf}} [W_{ue}(x) - V_{uu}]\, dF_f(x) \end{aligned} \tag{1}$$

with ρ the rate of time preference. Optimal search intensity s_j^* follows from solving $\tilde{s}_j, j = m, f$ from the first order conditions

$$\begin{aligned} \frac{\partial c(\tilde{s}_m, \tilde{s}_f)}{\partial s_m} &= \lambda_{um}^{'}(\tilde{s}_m) \int_{R_{um}} [W_{eu}(x) - V_{uu}]\, dF_m(x) \\ \frac{\partial c(\tilde{s}_m, \tilde{s}_f)}{\partial s_f} &= \lambda_{uf}^{'}(\tilde{s}_f) \int_{R_{uf}} [W_{ue}(x) - V_{uu}]\, dF_f(x) \end{aligned} \tag{2}$$

and setting $s_j^* = \iota(\tilde{s}_j > 0)\tilde{s}_j$. In empirical implementations of the model, regularity conditions on $c(s_m, s_f)$ and $\lambda_j(s)$ need to be imposed for a unique solution of s_j^*. An effective example is additive separability and concavity of $c(s_m, s_f)$ in combination with linearity of λ_j.[5] Value function (1) shows that the value of households with both spouses nonemployed equals the instantaneous utility of both partners being nonemployed minus the cost of search plus the gains of search for each spouse derived from getting an acceptable job offer. Reservation wages are implicitly defined by

$$W_{eu}(R_{um}) = V_{uu} = W_{ue}(R_{uf}) \tag{3}$$

which by (1) depend on the spousal income. Dey and Flinn (2008), Guler, Guvenen, and Violante (2012) and Flabbi and Mabli (2018) show that in the case of a linear utility function (risk neutrality) and pooling of household income, the value function as a whole becomes

[5] See e.g. Bloemen (2005).

additively separable and household members search and decide independently from each other such that the reservation wage does not depend on the spouse's income. Concavity (risk aversion) of the household utility function in household income leads to reservation wages that depend on spousal income.

The value function $W_{eu}(w_m)$ for a household with an employed husband with wage w_m and a nonemployed wife is

$$\begin{aligned}\rho W_{eu}(w_m) = u(w_m, b_f) - c(s_m^{**}, s_f^{**}) + \lambda_{em}(s_m^{**}) \int_{w_m} [W_{eu}(x) - W_{eu}(w_m)]\, dF_m(x) \\ + \lambda_{uf}(s_f^{**}) \int_{R_{ef}(w_m)} \max\{W_{ee}(w_m, x) - W_{eu}(w_m), W_{ue}(x) - W_{eu}(w_m)\}\, dF_f(x) \\ + \delta_m V_{uu}\end{aligned} \tag{4}$$

Value function (4) needs some more explanation as here some typical issues of household search arise. The model is quite accurately explained by Guler, Guvenen, and Violante (2012) and we sketch the issues here. First, in a couple with an employed husband and a nonemployed wife, the husband can search on-the-job and receive a job offer. As common in models containing on-the-job search, the current w_m establishes the husband's reservation wage while searching on the job. Then there is the chance that the wife gets an acceptable job offer. If the wife accepts a job, the husband is faced by the decision to continue working in his present job or to quit the job and become nonemployed. The latter can be motivated by the wife's wage offer being sufficiently high for the husband to become a nonparticipant, but also attractive search conditions for the husband while nonemployed may motivate the quit. The reservation wage for a wife with an employed husband with wage w_m is denoted by $R_{ef}(w_m)$. Equation (4) shows that for job acceptance by the wife she needs to have a wage offer x with $W_{ee}(w_m, x) > W_{eu}(w_m)$ or $W_{ue}(x) > W_{eu}(w_m)$. Defining $R_{ef}^{+}(w_m)$ implicitly by $W_{ee}(w_m, R_{ef}^{+}(w_m)) = W_{eu}(w_m)$ and $R_{ef}^{-}(w_m)$ by $W_{ue}(R_{ef}^{-}(w_m)) = W_{eu}(w_m)$ implies that the reservation wage is determined by the smaller of the two: $R_{ef}(w_m) = \min\{R_{ef}^{+}(w_m), R_{ef}^{-}(w_m)\}$. If the wife accepts, the husband faces the decision to quit. A quit is optimal if at wage offer x and given the husband's wage w_m it holds that $W_{ee}(w_m, x) < W_{ue}(x)$. Implicitly defined is the value $Q_m(x)$ for the husband's wage at which he is indifferent between quitting and staying:

$W_{ee}(Q_m(x), x) = W_{ue}(x)$. Thus, we can distinguish three cases. (i) $x < R_{ef}(w_m)$: the offer is rejected; (ii) $x > R_{ef}(w_m), w_m < Q_m(x)$: the offer is accepted and the husband's wage is low enough to quit; (iii) $x > R_{ef}(w_m), w_m > Q_m(x)$: the offer is accepted and the husband will stay since the value of his wage is high enough. Guler, Guvenen, and Violante (2012) formally prove the existence of the regimes.

Now for the purpose of interpreting our empirical result it is important to know how reservation wages move with the partner's wage. We already discussed that the risk neutrality can influence this: in case of risk neutrality (e.g. linearity of utility in income), partners search like independent individuals. If there is risk aversion the wife's reservation wage is most sensitive to the husband's wage in the quitting regime where the husband's wage is relatively low. That is the case where the wife's reservation wage is determined by $R^{-}_{ef}(w_m)$. The interpretation is that if the husband quits upon the wife's job acceptance, the wife's reservation wage needs to rise strong enough with the husband's wage in order to compensate for the income loss of the quitting husband. If the husband is in the staying regime (his wage is relatively high), this motive for the wife's reservation wage to move with the husband's wage disappears. Guler, Guvenen, and Violante (2012) show that in the staying regime it depends on the specific shape of the risk aversion in the household's utility function how the reservation wage moves with the spousal wage.[6]

First order conditions for $s_j^{**}, j = m, f$ in (4) are

$$\begin{aligned}
\frac{\partial c(\tilde{s}_m, \tilde{s}_f)}{\partial s_m} =& \lambda'_{em}(\tilde{s}_m) \int_{w_m} [W_{eu}(x) - W_{eu}(w_m)]\, dF_m(x) \\
\frac{\partial c(\tilde{s}_m, \tilde{s}_f)}{\partial s_f} =& \lambda'_{uf}(\tilde{s}_f) \int_{R_{ef}(w_m)} \max\{W_{ee}(w_m, x) - W_{eu}(w_m), W_{ue}(x) - W_{eu}(w_m)\}\, dF_f(x) \\
s_j^{**} =& \iota(\tilde{s}_j > 0)\tilde{s}_j, j = m, f
\end{aligned} \tag{5}$$

The difference between (2) and (5) shows that the wife's decision to participate and search depends on the husband's employment status and his income.

[6] The intuition behind it is that in the staying regime the husband's wage is relatively high, and with a concave utility function the marginal utility of income of the household is relatively low and gets even lower at higher wage values.Guler, Guvenen, and Violante (2012) show that in the constant absolute risk aversion case (CARA) reservation wages in the staying regime are independent of the spousal wage, while they are increasing in the spousal wage in case of decreasing absolute risk aversion (DARA), and decreasing in the spousal wage in case of increasing absolute risk aversion (IARA).

Note that the discussion so far concerns transitions from an unemployed wife with an employed husband into employment. It does not tell us yet so much about the transition of the wife out of employment into unemployed search or nonparticipation. Within the framework of the (stationary) household search model, these transitions can be governed by exogenous layoffs, as captured by the wife's layoff rate, by job acceptance of an unemployed husband, or by increasing husband's income on the job. To be more explicit about the behavior of the employed wife, we need to write down value functions $W_{ue}(w_f)$ for the nonemployed husband and the wife employed with wage w_f, and the value function of dual earner couples $W_{ee}(w_m, w_f)$. The first is the mirror image of the value function $V_{eu}(w_m)$ and defines the reservation wage $R_{em}(w_f)$ for the nonemployed husband with the wife employed at w_f and we do not write it explicitly. The dual earner value function is

$$\begin{aligned}\rho W_{ee}(w_m, w_f) =& u(w_m, w_f) - c(s_m^{***}, s_f^{***}) \\ &+\lambda_{em}(s_m^{***}) \int_{w_m} \max\left\{W_{ee}(x, w_f) - W_{ee}(w_m, w_f), W_{eu}(x) - W_{ee}(w_m, w_f)\right\} dF_m(x) \\ &+\lambda_{ef}(s_f^{***}) \int_{w_f} \max\left\{W_{ee}(w_m, x) - W_{ee}(w_m, w_f), W_{ue}(x) - W_{ee}(w_m, w_f)\right\} dF_f(x) \\ &+\delta_m W_{ue}(w_f) + \delta_f W_{eu}(w_m)\end{aligned} \tag{6}$$

The reservation wage for on-the-job searchers is their current wage, as standard in models with on-the-job search, but here also there is a decision to quit if the partner accepts a job with a higher wage. If the husband accepts a wage offer x with $x > w_m$, the wife will quit if $W_{eu}(x) > W_{ee}(w_m, w_f)$. Defining $S_f(x)$ by $W_{eu}(x) = W_{ee}(w_m, S_f(x))$ we distinguish three regimes. (i) $x < w_m$: the husband does not accept the job offer; (ii) $x > w_m, w_f < S_f(x)$: the husband accepts, the wife quits; (iii) $x > w_m, w_f > S_f(x)$: the husband accepts, the wife stays. This possibly implies that during the career as the husband climbs the wage ladder, while there is a gender wage gap, such that the wife does not foresee any further wage increases, she may decide to leave employment at some point.

3 Data

The data are from the OSA labor supply panel, a biannual survey at the household level, representative for the Dutch population. We use the waves 1986-2014 (initial year 1986 is only used for the initial states and variables). Each wave collects information on the respondents' labor market history at the monthly level in the previous two years.[7] Income and background characteristics are measured at the survey time. Using a time period of almost two decades also allows us to study developments over time and the impact of the cycle on labor market transitions. Spousal correlation in transitions due to both spouses being subject to the same cyclical effects can be allowed for. Selected in the sample are individuals with an age of at least 23 and at most 57 at the time of the survey.[8] Within a household we select couples of partners of the opposite sex, and we select couples for which information on both husband and wife is present.[9]

3.1 Labor market states

The three basic labor market states that we distinguish are nonparticipation, unemployed search, and employment. In theory (section 2), the distinction between nonparticipation and unemployed search is made on basis of whether one searches for a job or not. Nonparticipation is therefore defined as the individual being out of employment and reporting not to be searching for a job. Unemployed search is defined as being out of employment and reporting to search. In the survey, information on search by respondents is obtained at the time of the survey, but also the retrospective information on changes in labor market state in the past two years distinguishes between nonsearching nonemployed (e.g. nonparticipants) and searching nonemployed (e.g. unemployed search).[10]

[7] A well-known study that uses the early waves of the OSA labor supply panel is Van den Berg and Ridder (1998).

[8] Below the age of 58 nobody is eligible for occupational pensions, while most individuals finished full-time education at the age of 23.

[9] An advantage of the OSA data is that information on households is reasonably complete. OSA compares favorably to internet survey based panels in the Netherlands, such as LISS, that on paper contain more households, but much more often only one household member responds.

[10] Note that our definition of unemployed search is in accordance with the definition in search theory, but not necessarily with institutional definitions of "unemployment", that often add explicit requirements as direct availability for a job. This type of information is available at the time if the survey, but is not

To get an idea of how labor market states develop over time, Figure 1 shows sample percentages of the labor market states recorded at the survey time.[11] For comparison, figures for single men and women in the same age range are included as well. For men in couples, employment and nonparticipation rates look relatively stable across time. For women, strong upward and downward trends are observed in rates of employment and nonparticipation over the period 1988 through 2000. From 2000 on, rates remain relatively stable and a gap between employment and nonparticipation rates of men and women in couples persists. This flattening was also observed in the US (Blau and Kahn, 2006), where the steady level had already been reached in the 1990s.

Part of the difference between men in couples and single men may be simply explained by a different stage in the life cycle (age) of single men: the median age of men in couples is 43, while the median age of single men is 34. Single women used to have higher employment rates than women in couples, but from the year 2000 on the difference is not so clear anymore. Single women still have higher nonparticipation rates than men. Singles also tend to have higher unemployment rates than men and women in couples. Figure 1 shows the low unemployment and nonparticipation rates of men couples. Table 1 pools information for the subperiods 1988-1998 and 2000-2014. For women it recapulates the increase and decrease in employment and participation rates over time. For men, if anything, there is a slight decrease in nonparticipation and an increase in employment, although these differences may be cycle specific as well. To relate patterns in women's labor market states to developments in educational attainment, Table 2 shows the educational attainment over the subperiods. It shows decreases in the lowest education level, both for men and women, and increases in all other levels, while the difference between male and female educational attainment overall has become smaller. Table 1 shows, however, that also within education levels, including the lowest, nonparticipation rates decreased while employment rates increased. The differences in labor market rates between lowly and highly educated women are large, though.

Table 3 shows the correlation in states between spouses. Employment rates are higher if the spouse is also employed. In the raw data, that can come from correlation in observed

included in the retrospective information on labor market changes.

[11] The Figure is based on 17,915 pooled observations of couples, 3,944 observations of single men, 4,617 observations of single women.

as well as unobserved characteristics. The same holds for nonparticipation. Women with a nonparticipating husband are much more often nonparticipant themselves (48.9% versus 30.2% on average). Due to the downward trend in female nonparticipation, the correlation between male and female nonparticipation gets weaker over time. The nonparticipation rate for husbands with an unemployed wife is smaller than the average (2.5% versus 3.8% on average). This while wives with an unemployed husband are more than average nonparticipant (39.7% versus 30.2% on average), although this pattern decreased over time. Further we see that individuals with an unemployed spouse are more often than average unemployed searchers themselves.

3.2 Monthly transition rates

Table 4 shows monthly transitions rates. Within a survey wave respondents are asked for any changes in labor market state in the past two years and to report year and month of change. Thus, monthly transition rates can be determined on basis of this information.[12] Table 4 also shows the labor market transitions by spousal state. For men, transitions out of unemployment and nonparticipation into employment are higher if the spouse is employed. If the spouse is unemployed we see slightly higher transitions for men both from unemployment into employment and into the opposite direction. Transitions out of nonparticipation into employment and into unemployed search are higher for men with an unemployed spouse. Transitions from unemployment into nonparticipation are nonoccurrent for men with an unemployed spouse. Transition rates into employment are lower for men with a nonparticipating spouse, while transitions out of employment are not much different from the average if the spouse is a nonparticipant.

Since most husbands are employed, the women's transition rates are close to average for the women with employed husbands. For women with unemployed husbands, transition rates from employment into unemployment are higher as well. Transition rates into employment are lower if the husband is unemployed. The transition rate out of nonparticipation into unemployed search is higher for women with an unemployed husband. For women with

[12] Table 4 is based on the same 17,915 pooled couple-wave observations as before, but in total we observe 483,705 months with potential transitions.

nonparticipating husbands transitions into employment are lower while transitions from nonparticipation into unemployed search are lower as well. Women that are unemployed, though, disappear less often into the state of nonparticipation if the husband is nonparticipating.

Thus, first inspection of the transitions show patterns that can be explained by a mixture of correlation in observables and unobservables and elements from the household search model.

Trends in labor market states should also be reflected by trends in labor market transitions. Table 5 splits up the transition rates into the subperiods 1988-1998 and 2000-2014. For males, differences across subperiods are not large. For females, we see higher transition rates into employment (out of unemployed search and out of nonparticpation). At the same time, transition rates out of employment and into unemployed search and nonparticipation are lower in the second subperiod. Transitions from nonparticipation into unemployed search are higher in the second subperiod. So we see that higher employment rates and lower nonparticipation rates of women over time go together with higher transition rates into employment and out of nonparticipation and lower transition rates out of employment and into nonparticipation, such that all directions matter.

3.3 Spousal earnings

Figure 2 records the net monthly earnings of individual couple members, in real 2008 terms. We record couples of which earnings of both couple members are measured at the time of the survey.[13] Men on average have higher earnings than women. Throughout the period of observation, men with nonemployed spouses have higher earnings than average men in couples. Men with employed spouses are close to average, although consistently slightly below. Nonemployed men, relying on other income sources than wage earnings, have much lower earnings than average men. Nonemployed women have on average the lowest earnings of all categories displayed. Many nonemployed women in couples have zero earnings. Average earnings of employed women are still much lower than that of men since most women work

[13] This results in 15,515 pooled couples (here we excluded the initial year 1996. Incomes are observed at the time of the survey. Section 4.1 discusses missing incomes and how we deal with incomes of individuals experiencing transitions.

part-time.

Remarkable is the change across time in earnings of women with a nonemployed husband. Until 2000, these earnings followed the average, so the nonemployment status of the husband did not seem to matter. The average income of women with a nonemployed husband was even below the average earnings of nonemployed husband themselves. After that, the average income of women with nonemployed husbands is higher and closely follows the average incomes of employed women. That seems to suggest that female earnings within household income is becoming to play a more important role especially in times when the husband is jobless, and sort of helps in facilitating the joblessness of the husband.

This finding is in line with Figures 3 and 4 that show the fraction of women's earnings in total household in earnings. The left pane of 3 shows this fraction for the different subperiods. Throughout, we observe a big spike at zero, but this spike has decreased considerably during the two subperiods, related to the increase in female employment rates. The right pane is for employed women only and as such does not include the participation effect. We see a slight shift to the right, especially due to a decrease in the lowest fractions, but the largest share remains of the fractions remains below 0.5, meaning that there is not much progress in the share of women who earn more than their husbands. This observation is consistent with evidence for the US by Bertrand, Kamenica, and Pan (2015), who argue that a slow rate of change in gender identity norms keep the fraction below 0.5. Figure 4 shows the fraction diversified by husband's employment status. The left pane is for employed husbands, and is similar to the left pane of Figure 3. While the peak at zero still appears in the subperiod 1988-1998 and seems to be unaffected by the husband's employment status, it gets much smaller, not only across time periods but also across husband's employment status. This adds to the evidence in Figure 2 that suggests a relationship between female earnings and the husband's nonemployment.

3.4 Background characteristics

Table 6 shows descriptive statistics on background characteristics. It shows sample means and sample percentages of variables for the survey waves 1986-2014. The values are measured at the time of the survey. We define dummy variables for the absence children, and for

households with a youngest child in the age categories [0,3], primary school age range [4,12], secondary school age range [13,18], while households with the youngest child older than 18 serve as a reference category. Since all households with at least one child are classified in any of these categories, we define a variable for the number of children above one for households with more than one child. In some survey waves both year of birth and month of birth of children are recorded. That means that in a model with monthly transitions, we can construct the age of children at the monthly level. Other survey waves only record the year of birth of children and we can still assign yearly changes to the variables in the transition model. This means that in a model with time varying regressors, changes in children's ages (including birth) help in identifying the effect of children's age category on the transition probability.

Based on birthyear, some cohort dummies have been constructed. In Figure 1 we saw strong patterns over time in female labor market states and cohort effects may be part of the story. It is not the purpose of this study to decompose these observed changes into time effects, age effects, and cohort effects, but we want to check whether the effects of the variables of interest (mainly the spousal effects, but also the vacancy rate) are affected by some degree of flexibility in this respect. We interpret the different cohorts as generations, and the definition of cohorts is limited by the selected age range [23,57] and the survey waves, and we have to be aware that the oldest cohorts will not appear in the later survey waves, while the youngest cohort will not appear in the earliest waves. (Running into the well-known problem of distinguishing between time effects, age effects, and cohort effects. Later on we discuss the identification of cohort effects). For women, we distinguish a more refined pattern of cohorts than for men. For men, we hardly observe any pattern in Figure 1 anyhow.

4 Empirical methods

4.1 Analysis with transition data

We model transition probabilities with (potentially) time varying regressors. Let i be the index for household i, j and l for spouses $j, l \in \{m, f\}; j \neq l$. Let d_{ijt} denote the labor market state of spouse j in household i in period t, with t measured at the monthly level. It indicates the states of employment, unemployed search, and nonparticipation ($d_{ijt} = e, u,$ or n). Let x_{it} denote a vector of observed characteristics of household i in period t, q_{it}^j a vector of characteristics of spouse j in household i in period t and z_{it}^l characteristics of spouse l (household i, time t. It may include d_{ilt}). Furthermore, ν_{ij} denotes unobserved time-invariant heterogeneity for spouse j from household i that can be correlated with ν_{il}, the unobserved time-invariant heterogeneity of the other spouse in the same household. We write the probability that spouse j is in state d_{ijt} in period t, given that s/he was in state $d_{ij,t-1}$ in period $t-1$ as[14]

$$P_{d_{ij,t-1}}(d_{ijt}|x_{i,t-1}, q_{i,t-1}^j, z_{i,t-1}^l, \nu_{ij}), j, l = m, f, j \neq l \tag{7}$$

Since probabilities add-up to one over labor market states, we specify the transition probabilities explicitly for each state of origin, while the corresponding survivor probability follows. For $\nu_i = (\nu_{ij}, \nu_{il})$ we take a mass point distribution in the tradition of Heckman and Singer (1984), and we denote the mass points by $\nu_i^k = (\nu_{ij}^k, \nu_{il}^k), k = 1, ..., M; j, l = m, f; j \neq l$ with $P(\nu_i = \nu_i^k) = g^k(\nu_i^k)$. To handle the initial labour market state for period $t = 0$, we denote its probability by $H(d_{im0}, d_{if0}|X_{i,m,f,0}, \nu_i)$. Model parameters can be estimated by maximizing the likelihood function

$$\prod_{i=1}^{N} \sum_{k=1}^{M} \prod_{t=1}^{T} \prod_{j=m}^{f} P_{d_{ij,t-1}}(d_{ijt}|x_{i,t-1}, q_{i,t-1}^j, z_{i,t-1}^{l(j)}, \nu_{ij}^k) g^k(\nu_i^k) H(d_{im0}, d_{if0}|X_{i,m,f,0}, \nu_i^k) \tag{8}$$

[14] Modelling the data as discrete monthly transitions allows for incorporating potential monthly changes in covariates, which is easier in this framework than in, say, a continuous time duration model. The latter would also require complete information on the couple's history for the construction of backward recurrence times.

We choose the cumulative normal density function as a functional form for the transition probability $P_{d_{ij,t-1}}$ and specify it as a linear index of the variables $x_{i,t-1}, q^j_{i,t-1}, z^l_{i,t-1}$.[15]

The household search model (section 2) motivates the inclusion of the spousal labor market state $d_{il,t-1}$ and the spousal income in period $t-1$ in $z^l_{i,t-1}$. Recall (section 3) that within a survey wave we can track the labor market states of spouses monthly back to the time of the previous survey wave.[16] As such within household variation in spousal labor market states is exploited for identification. Variation across households also adds to the identification but differences across households can be subject to household specific heterogeneity, such as assortative mating. For that reason it is important to incorporate unobserved household specific heterogeneity ν_i. The estimation according to (8) governs the correlation between spousal labor market states and transitions via ν_i. The question is whether spousal income at $t-1$ correlates with ν_i. We definitely want to avoid the explicit modelling of income processes, since we have three different labor market states and imposing a specific structure for the income processes may do more harm than good. We will do something that is pragmatic and clever at the same time. But first let us review how income and unobserved heterogeneity is usually dealt with in duration and transition models. Nonemployment income, such as unemployment benefits, is commonly not specified as a stochastic process and it is commonly not allowed for correlation between the income and unobserved heterogeneity. For wage earnings, if any correlation is allowed for, it commonly runs via selectivity: wage offers are commonly modelled as not depending on unobserved heterogeneity but via preferences or arrival rates accepted wages may do so. These considerations lead us to the following procedure. First, since own income is not the variable of interest in our analysis, we exclude it from our base specification. Next, we estimate model variants without and with unobserved heterogeneity and initial conditions (the former greatly simplifies the estimation in (8)). Considerable differences in the outcomes for spousal earnings in certain transition probabilities across different estimation methods signal potential correlation between spousal income and unobserved heterogeneity. If that

[15] The implicit assumption is that $x_{i,t-1}, q^j_{i,t-1}, z^l_{i,t-1}$ only depend on ν_i through $(d_{im,t-1}, d_{if,t-1})$.

[16] Our aim not to explicitly model the endogenous spousal quitting that appears in the static and rigid household search model, but to allow the propensity to transit to change when the spousal labor market state changes.

situation occurs, we estimate an additional variant in which we interact spousal income with the discrete masspoints, as the impact of correlation will specifically manifest itself as different effects of spousal income in the transition probability for different unobserved groups.

Changes in individual labor market states usually go together with changes in income. Incomes are observed at the time of the survey. At the fringes of the two year survey period it is easy to assign incomes to months. The income from the previous wave can be assigned to the subsequent months, until a transition (if any) takes place. If a transition took place, the income from the survey wave itself can be assigned backward to the month until the month where the labor market state changed. This covers all cases with one transition. If more transitions took place and there are intermittent states, the same income as in the previous wave or current wave is assigned if an intermittent labor market state is the same as in the previous or current wave. If there is an intermittent labor market state that does not occur during the subsequent survey waves, we compute the intermittent income by applying a replacement rate of 70% to the observed income in the survey waves. If an individual is not included in the previous survey wave, we use nearest neighbour matching to assign an income value. We match exactly on year of the wave, labor market state, and sex, while inexact matching takes place on educational level, presence of children in the household (women only), labor market state in the subsequent wave, income in the subsequent wave. Nearest neighbor matching has the advantage that we do not have to impose any structure (which should satisfy the underlying household search model). It also automatically takes care of the zero income values of nonparticipating women (without the need of using additional methods to deal with corner solutions).

For the distribution of unobserved heterogeneity two support points $\nu_j^k, j = m, f; k = 1, 2$ for each spouse are specified. The second support point is normalized to zero ($\nu_m^2 = \nu_f^2 = 0$). We specify probabilities

$$P(\nu_{im} = \nu_m^k, \nu_{if} = \nu_f^l) = p_{kl}, k, l = 1, 2 \tag{9}$$

(which implicitly defines $g^k(\nu_i^k)$ in (8)). In the estimation we parametrize the probabilities

with parameters $\rho_{kl}; k = 1, 2; l = 1$ by setting[17]

$$p_{kl} = \frac{\exp(\rho_{kl})}{1 + \exp(\rho_{11}) + \exp(\rho_{12}) + \exp(\rho_{21})} \tag{10}$$

The coefficient of unobserved heterogeneity $\nu_k^r, k = m, f, r = 1, 2$, (appearing in the transition probability from state j to state l) is denoted as $\theta_{jl}^k, j, l = u, e, n$, and we normalize $\theta_{ue}^k = 1$. The specification (9) implies the expression for the marginal probabilities p_{jm} and p_{jf} ($j = 1, 2$) with

$$p_{1m} = P(\nu_m = \nu_m^1) = p_{11} + p_{12}, p_{1f} = P(\nu_f = \nu_f^1) = p_{11} + p_{21}, \tag{11}$$

and p_{2m} and p_{2f} the complements. If the unobserved heterogeneity between men and women is independent, it holds that $p_{jl} = p_{jm}p_{lf}$ (which contains only one independent restriction).[18]

4.2 Supplementary analysis with reservation wages and number of applications

The household search model (section 2) generates outcomes in terms of reservation wages and search intensity. The data contain variables related to the reservation wage and search intensity, and analyzing them can shed light on the underlying mechanisms. The survey collects information on reservation wages and on the number of applications in the past 4 weeks. This information is collected among survey respondents that report to be an unemployed searcher at the time of the survey. Theory does not a priori restrict the concept of reservation wage to searchers only. Among the searchers the response to the question on reservation wages is quite low. This is partly due to the structure of the survey, in which the respondent is asked for both an amount and a period of payment (in earlier waves weekly, four weekly, or monthly, and in later waves hourly, weekly, four weekly, monthly, and yearly), which is probably demanding for respondents. The structure also means that we need to make answers comparable by converting reservation wages to the same time interval. Since unemployed searchers also are asked to report desired working working hours

[17] p_{22} is implicitly defined by $p_{22} = 1/\{1 + \exp(\rho_{11}) + \exp(\rho_{12}) + \exp(\rho_{21})\}$.

[18] If there is independence, the parameters for men and women still need to be estimated simultaneously, since the likelihood contribution of a household is a mixture of four household types, depending on the composition of the two individual types.

we convert reservation wages to the hourly level. Amounts are expressed in 2008 prices. For men monthly reservation wages are on average 1584 Euro (standard deviation 542), while at the hourly level it measures 10.5 (3.8). For women, the numbers are 826 (446) and 9.2 (3.8). The supplementary analysis is done by regressing log-hourly reservation wages on background variables, as described in section 5.3.

The number of applications in the past four weeks is analyzed as a measure of the intensive margin of search, and we limit the analysis to searchers. Male unemployed searchers on average report 3.4 (4.8) applications in the past four weeks, while female unemployed searchers report 1.7 (2.8) applications in the past four weeks, approximately half of the search intensity of men. Section 5.3 presents results of Poisson regressions on this variable.

5 Results

Throughout the presentation of the estimation results we consider the spousal labor market state and spousal income as the variables of interest, since they are specific to the household search model. The other variable presented is the vacancy rate. Implications of the estimates for the trend over years will be presented graphically.[19]

Recall that we estimate transitions by month, but not all variables are measured at the monthly level. Within a wave education is constant. Age is measured at the yearly level. Age and presence of children in some waves can be measured at the monthly level (as we observe both year and month of birth) but in other waves only at the yearly level (as only year of birth is observed). Birth cohort is constant by definition. *Wave trend* is a time trend which we vary by month (and is measured in units of years).[20]

We exploit the availability of data over several years by including the vacancy rate as an indicator for the business cycle capturing demand side effects. This way we account for spurious correlation between husbands' and wives' transition rates caused by the business cycle that cannot be corrected for if this source of variation is absent. As an additional advantage, interpretable outcomes on the sensitivity of transition rates with respect to the

[19] Remaining covariates are considered as controls and estmates are presented in the Appendices.
[20] The wave trend variable has been normalized by subtracting 1988 from each year of the wave.

business cycle can be generated. The vacancy rate is measured yearly in September at the aggregate level and is a time effect in addition to the trend.

The specific structure of the two time effects (trend and vacancy rate) allows for the identification. The structure also gives room for adding the cohort dummies which are interpreted as representing generations, ranging from the oldest generation with mostly jobs for life to the youngest generation facing a more flexible labor market environment. In a fully flexible specification of time effects, cohort effects and age effects one is redundant as birth cohort and age add up to time. We emphasize that it is neither the aim nor the claim to identify cohort and time trends correctly from each other by this parametrization, but they are included as controls to make sure that the estimates of the parameters of the spousal variables are not driven by the complete absence of any time and cohort effects. As opposed to that, we do consider the vacancy rate as a variable generating potentially interesting outcomes such that adding time dummies is not an option.

Reference category for children in the household is households with the youngest child older than 18. Reference category for birth cohorts are cohorts born 1950 and before. Age has been divided by 10, incomes by 1000.

We present parameter estimates of the transitions obtained with three different methods. The first method does not include unobserved heterogeneity and hence does not involve initial conditions. The parameters of the transition models can be estimated separately by spouse and by state of origin in this case. In the sequel we refer to this as the 'simple method'. The second method follows the estimation procedure described in section 4.1 and maximizes likelihood function (8) incorporating unobserved heterogeneity as specified in (9). Accordingly, all parameters have been estimated simultaneously. The probabilities for the initial states are specified according to the equilibrium state probabilities described in Appendix B. The third method follows the same procedure, but is more flexible in the sense that initial conditions are allowed to deviate from the equilibrium states using a specification based on the error function, as described in detail in Appendix B. Complete tables of estimation results can be found in Appendix C, Tables C1-C6 for the simple method, Appendix D, Tables D1-D6 for the second method, and Appendix E, Tables E1-E8 for the third method.

Section 5.1 discusses the estimation results of labor market transition rates. Section 5.2

comments on the insights that are gained from the estimates of the distribution of unobserved heterogeneity. Section 5.3 presents results of a complementary analysis with reservation wages and search effort. Section 5.4 presents the simultaneous yearly transitions of couple members.

5.1 Labor market transitions

Tables 7, 8, and 9 show estimates of transition probabilities out of the respective states of unemployed search, employment, and nonparticipation. For men the most remarkable result is the effect of spousal income in the simple model. According to these estimates men have a lower rate of entering employment from unemployed search if spousal income is higher, and moreover, their transition rate out of employment into unemployed search is higher if spousal income is higher. The result is consistent with estimates for the reservation wage on a selective sample of unemployed searchers (section 5.3.1 and Table 11) that shows a positive estimate of spousal income on men's reservation wages. But the result for transitions is not robust to the inclusion of unobserved heterogeneity and initial conditions. In section 4.1 we argued that such difference could reflect correlation between spousal income and unobserved heterogeneity and it was proposed to re-estimate the model with interaction effects between spousal income and the support points of the unobserved heterogeneity distribution for the transitions from unemployment into employment and back. Results of this extended analysis for the transition from unemployed search in to employment reveal a significant coefficient of spousal income of -0.107 (standard error 0.046) for a distinct, small, group of men with less stability in their labor position state than the majority of men (see section 5.2 for details), while for the majority of men the coefficient is 0.009 and insignificant (standard error 0.055). For the transition from employment to unemployed search we find a coefficient of spousal income of 0.074, significant at the 10% level (standard error 0.042) for the less stable group of men and an insignificant coefficient of -0.015 (standard error of 0.113) for the stable majority.

For men we see that the vacancy rate notably affects (negatively) the transition out of employment into unemployed search. There is also a (less robust) positive effect of the vacancy rate on the transition from nonparticipation into employment.

The most remarkable spousal effect for women's labor market transitions is the positive

effect of spousal income on transitions into nonparticipation. This result is robust to the inclusion of unobserved heterogeneity and initial conditions and holds irrespective of the state of origin (employment or unemployed search). At the same time, transitions out of nonparticipation into employment or unemployed search are not affected by spousal income. The result is consistent with a career climbing husband and once husband's income is large enough the wife leaves the labor force, such that re-entering is unrelated to the husband's income.

There is a weak positive relationship between the unemployment status of the husband and the wife transiting from nonparticipation into unemployed search. For method 2, the accompanying p-value of the estimate is 0.101, just outside the range of significance at the 10% level, while significance at the 10% level is found for method 3. This provides (weak) evidence of an added worker effect. The descriptives in Table 4 also seemed to suggest a higher probability of nonparticipation into unemployed search if the husband is an unemployed searcher.

Like for men, women transit out of employment into unemployed search more often the lower is the vacancy rate. Unlike for men, we also find an effect of the vacancy rate in the opposite direction. Overall this gives the impression that women's labor market states are more sensitive to the cycle, which is supported by the graphical exposition later on (section 5.5).

There is some evidence of correlation between men and women concerning the states of nonemployment. Unemployed men with a nonemployed spouse are less likely to transit into employment, while employed women are more likely to transit into unemployed search if their spouse is unemployed (both findings being robust to the inclusion of unobserved heterogeneity).[21]

[21] Tables F1, F2, and F3 show a sensitivity analysis for the simple model with an extended set of spousal regressors to check whether coefficients of spousal labor market state and income are much affected. Comparison with Tables 7, 8, and 9 show the robustness of the results.

5.2 Parameters distribution unobserved heterogeneity

Table 10 contains the parameters of the distribution of unobserved heterogeneity for method 2. (See the specification in Section 4.1).[22] It includes the estimates of the support points $\nu_j^1, j = m, f$, the parameters θ_{jl} of the support points in the transition probabilities (with θ_{ue} normalized to one for each spouse), and estimates ρ_{kl} that set the probabilities according to equation (10). From the latter the probabilities are computed with the accompanying standard errors obtained by the delta method. Marginal probabilities have been defined in equation (11). During the estimation we restricted the parameter θ_{un}^m to zero since the likelihood function appeared quite flat in this parameter.

For men, the implication is that there is an unobserved group of 7.6% of men (see the marginal probability of p_{1m}) that is different from the rest and experiences transitions in various directions more frequently (see the overall positive values for θ_{lj}^m, indicating that the direction of the transition does not matter).

For women, there is a group of 15.6% with opposite effects on transitions from employment into nonparticipation (parameter θ_{en}, positive) and from nonparticipation into employment (parameter θ_{ne}, negative). Since ν_f^2 is normalized to zero, while the estimate of ν_f^1 is significantly positive, the implication is that this group of the women is less attached to the labor market (with a higher probability to exit and a lower probability to enter).

Since these men and women interact, we have four different household types, where the most common group of 78.8% are households where men make transitions infrequently and women are attached to the labor force. We computed the correlation coefficient of unobserved heterogeneity between men and women, which is 0.067, showing that the unobserved heterogeneity between women (being less attached to the labor force) and men (making transitions more frequently) are not much related to each other.[23]

[22] The results for method 3 are not fundamentally different, although there are small numerical differences in the estimates. Results for this method are in Table E8.

[23] We also computed the likelihood ratio test statistic for independence, by first estimating a variant that imposes independence (see end of section 4.1). The LR statistic is 2.9 which is to be compared with the critical value of the $\chi^2(1)$ distribution, which is 3.8, implying that absence of correlation cannot be rejected. As noted earlier, this does not mean that models can be estimated separately for men and women, since the model contains spousal variables and the likelihood contribution is a mixture. Indeed, a likelihood ratio test clearly rejects separate estimation.

5.3 Results supplementary analysis with reservation wages and search effort

5.3.1 Reservation wages

Table 11 contains the results of the supplementary analysis with reservation wages, discussed in section 4.2. The dependent variable is the log of the hourly reservation wage at the weekly level.[24] For reason of comparison, the same set of variables is included as in the transition equations. To that we add own income and the log of desired hours.

The reservation wages of men rise with the income of the spouse. We check whether the effect of husband's own income is different depending on whether the wife is a nonparticipant (and therefore mostly has zero income), by including a cross effect between the husband's own income and a dummy indicator for the wife's nonparticipation. The results are in the central columns of Table 11 and show that if the wife is a nonparticipant, the husband's reservation wage is much more responsive to his own unemployment income. This reflects that male breadwinner households are more sensitive to the risk of the husband's unemployment, while households with an income providing wife are better able to cover risks.

Spousal income has no effect on reservation wages of women. At first sight it seems surprising that men's reservation wages are responsive to women's income, while women's reservation wages are not responsive to men's wages. But it is consistent with the household search model described in section 2, (and in Dey and Flinn (2008) and Guler, Guvenen, and Violante (2012)). It tells that the reservation wage is more responsive to the spousal wage if it is low since at low values the spouse withdraws from the labor market and a wage offer needs to compensate for that, while it is less or even completely irresponsive to the spousal wage if it is high, since in that case the spouse will not resign from the labor market as a result of job acceptance. Now the wife's earnings are generally low compared to the husband's earnings (see Figure 2) making it less likely that the husband will leave the labor market upon job acceptance of the wife, while it may be more likely that the wife leaves the

[24] It should be clear that the reservation regression equation is by no means interpretable as a functional form for the reservation wage generated by a structural household search model. The latter contains peculiar nonlinearities in spousal income and thorough identification of such linearities would require the availability of multiple observations for the same individual.

labor market (consistent with the results for transitions in Tables 7 and 8).

This contrasts with the effect of spousal income in the standard labor supply model (expressed in terms of labor market states and hours, rather than transitions across states), where spousal income generates an income effect that decreases the probability of employment. The spousal income in the reservation wage of the household search model does not represent that simple income effect but the amount of income that the job acceptor needs to cover if upon job acceptance the spouse quits. And outside the rigid, literal structure of the household search model the asymmetry of the effect of spousal income on reservation wages of men and women that we find implies that the income that the wife accepts is considered as an income source on top of the husband's income (rather than a replacement), while the income that the husband accepts should be large enough to replace at least part of the wife's income.

5.3.2 Search effort

In the data, the number of applications in the past 4 weeks is available as a measure of search effort. In the literature other measures emerge. Robert Shimer (2004) aggregates different search channels and uses this aggregate number as a measure of search effort. Krueger and Mueller (2010; 2012) use information on time spent on search, obtained as time diary information in time use surveys. They pool singles and couples in their analyses, but show that for specific countries time spent on search is lower for married women than for singles.

By theory, search effort reflects a trade-off between marginal returns to search and marginal cost of search and recognizing this is potentially helpful in interpreting outcomes. Table 12 shows results on the number of applications in the past 4 weeks obtained with Poisson regressions. As an additional variable we included dummy variables for having unemployment insurance or welfare benefits as income sources, since eligibility for these benefit types comes together with search requirements (and as such affects gains and costs of search).

Women with a higher spousal income search less, while men's spousal income does not affect their search effort. It is opposite to what we find for reservation wages, but on average men search more than women anyhow and sensitivity of cost of search with respect to spousal income can be different at different levels if the cost of search function is concave.

The search effort of men is sensitive to own income if the spouse is a nonparticipant, again reflecting the higher risk of male breadwinner households to the unemployment of the breadwinner. Male breadwinner households depend more on social insurance benefits. Also women search less if their own nonemployment income is higher. Note that receiving unemployment insurance benefits adds positively to search effort, which can be attributed to search requirements or be a sign of a higher labor force attachment.

The birth cohort dummies and the time trend for women's search effort are consistent with an increasing attachment of women to the labor market, as expressed by higher numbers of applications across time and generations.

For men we find a positive effect of the vacancy rate, suggesting that men send out more applications if the vacancy rate is higher. This while the estimates of the transition model showed that higher vacancy rates do not go together with higher transition rates from unemployed search to employment for men (Table 7). This suggests that higher vacancy rates go together with lower search cost rather than with higher effectiveness of search. For women we find an opposite result: the vacancy rate does not play a role in explaining search effort, while higher vacancy rates for women do go together with higher transition rates for women from unemployed search into employment (Table 7). Thus, for women higher vacancy rates are effective at the extensive margin in terms of higher transition rates, but at the intensive margin higher vacancy rates do not induce women to search more intensely.

5.4 Simulation of transitions along a one year period

The parameter estimates do not provide insight in the incidence of the transitions, while transition probabilities at a monthly level are awkward to interpret. Therefore the estimates of the monthly transition probabilities have been used to simulate transition probabilities over a yearly (12 months) period. In the base simulation, the transition probabilities are evaluated in average sample characteristics over the sample period. The time trend is set at year 1988, and cohort dummies are set in accordance with time trend and at average age (42 for men, 40 for women). Initial incomes are set to the genderspecific median (and change upon a transition during the twelve months simulation). Table 13 shows the probability (in %) that a couple that initially was in state ij (i labor market state man, j labor market

state woman) is in state kl twelve months later.[25] Interesting couple types are dual earners, labelled ee, and male breadwinner couples, en. Couples with at least one unemployed partner (u) a priori are expected to show less persistence and more movements towards other states.

If the initial state is un (searching husband, nonparticipating wife) a situation where 12 months later the husband is still searching but the wife is participating (uu or ue) is related to the added worker effect (the most important cases are shaded orange). In 2.41% of the initial un cases the wife has become a searcher (uu) while in 4.29% she has got a job while the husband is still searching (ue). Most un couples end up as male breadwinner (en) couples (over 18%). For couples with both spouses searching (uu) women give up searching and enter nonparticipation easier than men. For 23.61% the wife is employed one year later while the husband is searching (ue). Out of initial ue couples about 30% are dual earners a year later, while very few end up as male breadwinner couple. Initial ue couples are the only state of origin where we find a percentage above 1.5 of husbands ending up as a nonparticipant.

The traditional sole male breadwinner couple en and the dual earner families ee show most persistance (shaded yellow). Of the male breadwinner couples almost 92% is in the same state one year later, and for the remaining 1.58% ends as an eu couple and 6.14% as a dual earner couple. The stability of the husband's employment state is big for these couple types. For initial dual earners ee we find that over 94% still is a dual earner one year later. Transitions out of dual earnership are mostly due to instability of the wife's employment status. 3.52% end up as male breadwinner couples and for 1.61% of the couples the wife is searching for a job one year later. There is a fair percentage of over 35 of the eu couples that end up as dual earner couple, but at the same time 4.33% ends as a male breadwinner couple.

Since dual earners and sole male breadwinner couples are the most stable, it is important to realize how the inflow into these states (shaded green for dual earners and red for male breadwinners) develops due to changes.

The simulations were repeated with average characteristics (such as education levels,

[25] For each state of origin 100000 12 month periods of labor market states are simulated, using the estimated transition probabilities, and the frequencies of the state of destination at the end of 12 months are recorded. Standard errors for the differences are obtained by repeating the simulations for 100 different parameter vectors drawn from the asymptotic distribution of the maximum likelihood estimates.

household composition) for the periods 1988-1998 and 2000-2014 separately, keeping the trend year, the vacancy rate, the average age and cohorts at the same values as the base specification. Thus, results mainly measure the change in transition probabilities due to the change in sample composition across time. Transition probabilities in period 2 that differ significantly from their counterparts in period 1 are marked in the table. Probabilities of ending up as an *un* couple are significantly lower in period 2, while the probability that the woman enters the labor market or starts working while her husband is unemployed increased, showing that overall couples in period 2 can better deal with situations with an unemployed husband. Probabilities that a couple ends up as a dual earner couple, irrespective of state of origin, are significantly higher in period 2 than in period 1. This includes a higher stability of dual earner couples. The probability of ending up as a male breadwinner couple *en* is significantly lower in period 2, except for initial *un* and *uu* couples.

The role of combined trend and cohort effects is exposed in the fourth simulation. Characteristics are at the same as in the base specification again, but the trend is set to year 2012 and cohort variables are set accordingly and consistent with the average ages. The Table marks transition probabilities that are significantly different from the base. In *un* couples, the woman is more likely to step in as a searcher than in the base simulation. Similarly, the probability that a *ue* couple becomes *un* has decreased. Families that initially are male breadwinner families experience a much lower persistence in remaining in that state, while the probability that a dual earner couple remains a dual earner couple increased. Overall, inflow in dual earnership increased, although the increase is not signifiicant for all states of origin. All in all, the trends seems to pick up important movements from a labor market with more dual earners and less male breadwinner couples. The trend also shows some significantly reduced transitions into nonparticipation for employed men.

In the base simulation the vacancy rate is at the average value over the sample period. We increase the vacancy rate to a high level (the level at the beginning of the century, which is historically high, but not as high as just before the 2008 crisis). The Table marks probabilities that are significantly different from the base. The persistence of the state *uu* when both spouses are unemployed searchers is much lower if the vacancy rate is high with significantly higher probabilities of either spouse entering employment (although no

significant effect on dual earnership is detected), while quantitatively the effect is bigger for women. A positive effect on dual earnership (ee) is only for couples where the husband is employed initially (possibly because an added worker effect is less relevant in an environment with a high vacancy rate). Couples with an initially employed husband are less likely to end up as a couple with an unemployed husband. The state with an employed husband and a searching wife is much less persistent with a high vacancy rate and these couples shift to ending up as dual earners. The probabilities of ending up as a male breadwinner (en) couple do not seem to be affected by the vacancy rate.

To highlight the impact of women's education, results are generated separately for a lowly educated woman and for a highly educated woman, leaving everything else as in the base. The Table marks transition probabilities for highly educated women that differ significantly from those for lowly educated women. Highly educated women are much more likely to end up with a job, irrespective of the state of origin. That includes a higher share of dual earner couples, and a higher stability of dual earner couples. Couples with both spouses searching are at higher risk of remaining in that state if the wife's education level is low. The chance of ending up as a male breadwinner couple (en) is much lower among highly educated women. From all the variants run the male breadwinner state is the least persistent if the wife has high education. Couples with a nonparticipating husband and an employed wife seem to be more prevalent among the higher educated women, while couples with both spouses nonparticipating are less prevalent.

Transition rates for childless couples are compared to the base specification. Quantitatively the differences with the base are not very big. Dual earner couples and male breadwinner couples are more, respectively less, persistent than the base. The situation where both spouses are unemployed is less persistent than the base, although there are no precise results on destinations. Couples with an unemployed husband and a nonparticipating spouse also seem to be less prevalent (lower persistence, lower inflow). Inflow into couples with a nonparticipating husband and an employed wife is somewhat higher for childless couples.

The specification of unobserved heterogeneity gives us four different household types. Each spouse has two support points, the second being normalized to zero, and couples with both the second support point are most prevailing. Men with support point 1 move more

often, while women with support point 1 are less attached to the labor market. Table 14 shows results for the different combinations of support points. The bottom (both spouses type 2) has the highest probability and hence is closest to the base simulation in Table 13. For the remaining groups we find striking differences. For couples where the wife is of type 1 (less attached to the labor market), the chance of remaining a dual earner couple is around 30% points lower than in the base. If the husband is of type 1 male breadwinnership is less stable. Type 1 men have a higher probability of entering employment but also a higher probability of exiting again giving a lower stability for this couple type. Contrary to that couples with an initial unemployed searching type 1 woman enter dual earnership at a higher rate, but apparantly this is more than compensated by higher exit rates out of dual earnership.

Overall, the simulations show that the trend has a big effect in explaining changes over time, the education level captures large cross-sectional differences, while the unobserved heterogeneity reveals the existence of couple type where the wife is much less attached to the labor market and couples with less labor market stability of husbands.

5.5 Simulated labor market states: trend and cycle

Figure 1 showed strong trends in female labor participation over the year. With the estimates we can calculate percentages for labor market states over the years and decompose them into trend effects, cyclical effects, and effects due to changes in observed characteristics over the years. Figure 5 shows the labor market states according to the model by gender and year (using model variant 3). By year labor market states are averaged over the sample. We show the time patterns with and without trend, and with and without business cycle (in the latter case the vacancy rate is kept at its average). Developments in female employment and nonparticipation are largely picked up by the trend in the model. Changes in sample characteristics over time explain only around 5% points of the increase (decrease) in employment (nonparticipation). Women's unemployment is more sensitive to the cycle (vacancy rate) than men's (reflecting the higher sensitivity of women's transition rates with respect to the vacancy rate).

Figure 6 show results by unobserved heterogeneity type for men that move more often (support point ν_m^1) and the women that are less attached to the labor market (ν_f^1). These

men show lower employment rates, higher unemployment and nonparticipation, and a higher sensitivity to the cycle. These women have much lower employment and corresponding higher nonparticipation rates. Their unemployment rates seem to rise over time relative to the base, suggesting increased efforts to search and participate.

6 Conclusions

Household labor supply is usually studied in a static framework with labor market states and hours as outcome variables. This study analyzes labor market transitions for men and women in couples, distinguishing the states of nonparticipation, unemployed search, and employment. The analysis is motivated by the household search model, but we do not a priori impose any of the stylized structure derived from the model and observe what the data tell us. In presenting outcomes, the emphasis is on spousal variables, but the analysis also casts light on the impact of the business cycle and other background characteristics. Our model also gives insight in the development of labor market states across time.

While in static models of household labor supply the emphasis is on the negative income effect of husband's income on the wife's participation, our results from the transition model show an interesting asymmetry. Women exit the labor market easier while husband's income rises, but an impact of husband's income on labor market entry cannot be detected. This is consistent with an interpretation where women at some point exit the labor market while the husband climbs the career ladder. Policy directed at circumventing women from exiting the labor market therefore seems more effective than employing financial incentives to induce women to re-enter once they became nonparticipant.

Outcomes for men suggest that with increasing labor market participation of women, households with unemployed men become less dependent on unemployment insurance benefits and the wife's earnings add to facilitating the husband's spell of nonemployment. Several independent sources of information from the data point in this direction. First, descriptives on earnings reveal the increasing role of women's earnings for couples with a nonemployed husband. Second, regression results indicate that unemployed searching men have lower transition rates into employment the higher are the wife's earnings and higher transition

rates into the opposite direction. These results are sensitive to the inclusion of unobserved heterogeneity, but seem to remain for a subgroup of men that make transitions more frequently than the majority of men. Third, the result is supported by a supplementary analysis with reservation wages. Next, the husband's search effort is sensitive to own income only if the wife is nonparticipant.

From the point of view of the static labor supply model it seems counterintuitive that men's transitions and associated reservation wages are affected by spousal income, while women's are not, but the phenomenon can be interpreted in terms of the implications of the household search model that includes quit behavior. Women's earnings are usually low compared to men's earnings such that upon job acceptance of a husband, the wife may quit. Thus, the husbands reservation wage needs to incorporate and cover the loss (or, more general, reduction) of the wife's earnings and therefore rises with the wife's earnings. For the same reason, the husband is unlikely to quit if the wife accepts a job and the wife's reservation is far less sensitive to the husband's earnings. The more general story is that the wife's earnings on job acceptance are considered as an income source on top of the husband's earnings, while husband's earnings on job acceptance should be large enough to replace part of the wife's earnings (either immediately or in the future).

A weak added worker effect is shown by an increase in the women's transition rate out of nonparticipation if the husband is an unemployed searcher.

The specification of unobserved heterogeneity in the transitions model reveals that there is a sizeable group of women with considerable smaller transition rates from nonparticipation into employment and larger transition rates in the opposite direction and have employment rates that are over 30% lower than the base. Associated couples are much more often male breadwinner couples while dual earnship prevails less. Through the years, though, we see that these women enter unemployed search more often, probably indicating an increased intention to participate. Since this group of women is identified by unobservables it is hard to formulate policy, but this hard-to-reach group may be responsible for roughly half of the remaining female non-participation gap. It is important to realize that this lower labor force participation cannot be explained by conventional observed covariates that are included in the model, such as education level, age, cohorts, presence and number of children. Things

like differences in gender roles in different parts of the population probably underly the gap in labor force participation.

The inclusion of vacancy rates can pick up spurious spousal correlation due to the business cycle. At the same time, the outcomes for the vacancy rate are interpretable. Over all, both men and women's layoff rates are sensitive to the vacancy rates, but notably women's labor market transitions back into employment and out of nonparticipation seem to be more sensitive to the business cycle fluctuations. For search effort (intensive margin), though, we find a higher sensitivity for men, indicating that search effort for them rises with the vacancy rate.

Strong upward and downward trends in women's employment and nonparticipation rates observed in the data are largely picked up by the model's trend variable, while developments in women's background variables (such as educational attainment) over time play a smaller role. This shows that the major changes in women's labor force participation cannot be explained by conventional background variables and alternative explanations, such as changing gender identity norms, are to be searched for.[26]

7 Discussion

The study provides us with a bigger picture of the labor market movements of couples over a certain time period. The aim is not to implement a structural economic model, even though the household search model is very helpful in interpreting outcomes, but to generate data driven results that are not a priori imposed. Particular results, such as the asymmetry of spousal income with respect to transitions into and out of women's employment and the role of spousal earnings during men's unemployment spells, are unsought and not often demonstrated in earlier studies. The methods also identify a sizeable group of women that

[26] A study by Fernández, Fogli, and Olivetti (2004) endogenizes the trend and incorporates that over generations employed mothers set the example to their sons leading to different gender roles in households. Fernández (2013) models a learning mechanism that over time and generations more is learned about the value of women's time. It should be noticed that our samples starts at the end of the eighties, such that for our sample period the upcoming of time saving household appliences does not apply as explanation for the trend in women's employment. The same holds for the rise of part-time jobs: at the start of our observation periods average working weeks of 23 hours for women were common already, which is the same as at the end of our sample period.

is less attached to the labor market which by itself can be a reason why the gap in labor force participation between men and women persists.

There are plenty of issues left that we do not address. In particular, we do not focus on specific policy measures directed to specific transitions in specific time periods. This requires data that are far more granular and a focus on a limited time period and maybe a transition in a specific direction for a specific spouse. Given that nowadays any policy measure will become the object of a policy evaluation study we are not afraid that such analyses will remain uncovered in the literature.

Since the prime focus of our study is spousal interaction in labor market transitions, it is good to discuss identification. An important source of identification is within household changes in spousal variables. Transition probabilities change if spousal states change. That means that timing is important. Reverse causality would be measured if household members react to spousal changes *in anticipation* and *in advance* of the actual change. The question is whether household members have incentives to act this way. Such an incentive will not come from the actual income change due to a change in the spousal labor market state, since this income change materializes upon the actual change in the state, so from this point of view reacting in advance makes no sense. But it is thinkable that in anticipation of search frictions a nonparticipating spouse starts searching in anticipation of the job loss of the partner. This could attribute to (while certainly not being the only reason for) a positive coefficient of spousal unemployment in the layoff probability of men. However, in our empirical results evidence for this hypothesis is explained away by unobserved heterogeneity.

Static labor supply models focus on working hours, and deal with both the intensive and extensive margin of the labor market. Within the framework of household search (conform Flabbi and Mabli, 2018) one could think of distinguishing the labor market states part-time and full-time employment. However, in our data labor market histories in terms of the labor market states nonparticipation, unemployed search and employment can be constructed at the monthly level but hours are only observed at the time of the survey. Think also what an additional refinement into part-ime and full-time employment would bring. Since we have already transitions from nonparticipation and unemployed search to employment and back the main addition would be allowing for transitions between part-time and full-time

employment and back. That certainly is a relevant issue, but given that we have already covered many issues and the data limitations ask for a separate analysis outside our model we leave the subject for a next study.

Finally, we had already pointed at the selective nature of the sample. A sample of couples is selective since it implicitly includes the decisions of matching and divorce. These decisions can be related to labor market states. Note that such selectivity is even present in a cross sectional sample, but in a study of labor market transitions its presence is more explicit, even to outsiders. For instance, job loss may lead to divorce, ending the couple relation. There is little we can do about but remaining aware that such selectivity is present. And, too, it is unlikely that our results are completely driven by endogenous divorce or matching. Although a large share of couples is faced by divorce during their lifetime, labor market transitions are more prevelant, and if every labor market shock were to affect couple status, there would hardly be a reason of existence for household labor market models, since agents would act as individuals anyhow. Apart from matching and divorce, there are issues like health and mortality that may affect or be affected by labor market states and transitions.

Table 1: Labor market states of men and women in couples, aged 23-57, across time: sample percentages

Men in couples									
	All education levels			lowest education level			Higher and University level		
Labour market state	1988-2014	1988-1998	2000-2014	1988-2014	1988-1998	2000-2014	1988-2014	1988-1998	2000-2014
Employed	94.2	92.9	95.4	91.1	90.6	91.9	97.1	96.3	97.5
Unemployed	2.1	2.5	1.7	2.8	3.2	2.0	1.3	1.5	1.2
Nonparticipation	3.8	4.6	3.0	6.2	6.2	6.1	1.6	2.2	1.4
Women in couples									
	All education levels			lowest education level			Higher and University level		
Labour market state	1988-2014	1988-1998	2000-2014	1988-2014	1988-1998	2000-2014	1988-2014	1988-1998	2000-2014
Employed	66.3	54.5	77.7	51.6	44.1	64.9	85.3	77.1	88.7
Unemployed	3.5	4.0	3.0	3.6	3.9	3.0	3.3	5.3	2.5
Nonparticipation	30.2	41.5	19.3	44.8	52.0	32.1	11.4	17.6	8.9

Table 2: Education levels of men and women in couples, 23-57, across time: sample percentages

Men in couples			
Education level	1988-2014	1988-1998	2000-2014
Lower	38.8	50.1	28.1
Intermediate	33.5	30.4	36.4
Higher	20.0	15.2	24.5
University	7.8	4.3	11.1
Women in couples			
Labour market state	1988-2014	1988-1998	2000-2014
Lower	42.1	55.3	29.6
Intermediate	35.8	31.6	39.8
Higher	17.8	11.5	23.9
University	4.3	1.6	6.8

Table 3: Labor market states by spouse's state: sample percentages

1988-2014		Labor market state spouse		
	Overall	Employed	Unemployed	Nonpart.
Men:				
Labour market state:				
Employed	94.2	95.6	92.7	91.2
Unemployed	2.1	1.6	4.8	2.7
Nonparticipation	3.8	2.8	2.5	6.1
		Labor market state spouse		
	Overall	Employed	Unemployed	Nonpart.
Women:				
Labour market state:				
Employed	66.3	67.3	52.2	48.7
Unemployed	3.5	3.5	8.1	2.4
Nonparticipation	30.2	29.2	39.7	48.9
1988-1998		Labor market state spouse		
	Overall	Employed	Unemployed	Nonpart.
Men:				
Labour market state:				
Employed	92.9	95.0	91.3	90.3
Unemployed	2.5	1.7	5.4	3.2
Nonparticipation	4.6	3.2	3.4	6.6
		Labor market state spouse		
	Overall	Employed	Unemployed	Nonpart.
Women:				
Labour market state:				
Employed	54.5	55.7	38.3	38.0
Unemployed	4.0	4.0	8.8	3.0
Nonparticipation	41.5	40.3	53.0	59.0
1998-2014		Labor market state spouse		
	Overall	Employed	Unemployed	Nonpart.
Men:				
Labour market state:				
Employed	95.4	96.0	94.6	93.0
Unemployed	1.7	1.6	4.0	1.8
Nonparticipation	3.0	2.5	1.5	5.2
		Labor market state spouse		
	Overall	Employed	Unemployed	Nonpart.
Women:				
Labour market state:				
Employed	77.7	78.2	71.9	64.7
Unemployed	3.0	3.0	7.2	1.5
Nonparticipation	19.3	18.8	20.9	33.8

Table 4: Labor market transitions by spouse's initial state: monthly transtion rates in %

1988-2014	Men			Women		
	To E	To U	To N	To E	To U	To N
Whole sample						
From E	99.86	0.10	0.04	99.64	0.16	0.20
From U	4.48	95.27	0.26	4.11	95.40	0.49
From N	0.69	0.12	99.19	0.54	0.12	99.34
Spouse Employed						
From E	99.87	0.10	0.03	99.64	0.15	0.20
From U	5.76	93.95	0.29	4.15	95.36	0.50
From N	1.04	0.19	98.78	0.56	0.13	99.31
Spouse Unemployed						
From E	99.78	0.17	0.05	99.33	0.42	0.25
From U	3.97	96.03	0.00	3.97	95.34	0.69
From N	1.33	0.38	98.29	0.46	0.18	99.36
Spouse Nonpart.						
From E	99.85	0.10	0.06	99.70	0.14	0.16
From U	2.98	96.77	0.26	3.42	96.39	0.19
From N	0.28	0.04	99.68	0.26	0.04	99.70

Table 5: Labor market transitions by period: monthly transtion rates in %

Period	Men			Women		
	To E	To U	To N	To E	To U	To N
1988-2014						
From E	99.86	0.10	0.04	99.64	0.16	0.20
From U	4.48	95.27	0.26	4.11	95.40	0.49
From N	0.69	0.12	99.19	0.54	0.12	99.34
1988-1998						
From E	99.84	0.11	0.05	99.51	0.20	0.30
From U	4.18	95.56	0.26	3.50	96.03	0.47
From N	0.72	0.12	99.16	0.47	0.08	99.44
2000-2014						
From E	99.87	0.10	0.03	99.73	0.13	0.14
From U	4.96	94.79	0.25	4.92	94.56	0.52
From N	0.63	0.12	99.25	0.67	0.21	99.12

Table 6: Background characteristics, wave 1986-2014

Variable	# obs.	mean	std. dev.
Age husband	19,078	42.3	8.5
Age wife	19,078	40.0	8.6
Monthly income husband	17,367	1958.0	949.4
Monthly income wife	17,654	691.1	691.9
# children > 1	19,078	1.4	1.3
Variable	# obs.	percentage	
Educ 1 husband: Primary, lower/intermediate secondary/ lower vocational	18,970	39.3	
Educ 2 husband: Higher secundary/ intermediate vocational	18,970	33.5	
Educ 3 husband: Higher vocational	18,970	19.7	
Educ 4 husband: University	18,970	7.5	
Educ 1 wife: Primary, lower/intermediate secondary/ lower vocational	18,949	43.2	
Educ 2 wife: Higher secundary/ intermediate vocational	18,949	35.4	
Educ 3 wife: Higher vocational	18,949	17.3	
Educ 4 wife: University	18,949	4.1	
No children in household	19,078	23.9	
Youngest child in age range [0,3]	19,078	17.5	
Youngest child in age range [4,12]	19,078	29.1	
Youngest child in age range [13,18]	19,078	19.1	
Birth cohort husband ≤ 1950	19,078	28.4	
Birth cohort husband $(1950, 1965]$	19,078	51.8	
Birth cohort husband > 1965	19,078	19.8	
Birth cohort wife ≤ 1950	19,078	22.3	
Birth cohort wife $(1950, 1960]$	19,078	32.2	
Birth cohort wife $(1960, 1970]$	19,078	32.5	
Birth cohort wife > 1970	19,078	13.1	

Table 7: Estimates of monthly transitions out of Unemployed Search

	men				women			
	into Employment		into Nonparticipation		into Employment		into Nonparticipation	
Variable	Est.	se	Est.	se	Est.	se	Est.	se
Simple model of labor market transitions								
Spouse unempl.	-0.221*	0.130			-0.064	0.115	0.287	0.189
Spouse nonp.	-0.274**	0.069	-0.090	0.153	-0.067	0.131		
Income spouse	-0.070**	0.036	-0.130	0.095	-0.028	0.025	0.080*	0.046
Vacancy rate	0.0004	0.005	0.017	0.013	0.014**	0.004	0.010	0.007
Model of labor market transitions with unobserved heterogeneity and initial conditions								
Spouse unempl.	-0.237**	0.103			-0.077	0.107	0.310	0.189
Spouse nonp.	-0.263**	0.060	-0.050	0.146	-0.080	0.111		
Income spouse	-0.020	0.031	-0.013	0.123	-0.023	0.027	0.105**	0.043
Vacancy rate	-0.003	0.004	0.011	0.012	0.015**	0.003	0.012	0.008
Model of labor market transitions with unobserved heterogeneity, flexible initial conditions								
Spouse unempl.	-0.185*	0.105			-0.046	0.105	0.319*	0.187
Spouse nonp.	-0.281**	0.062	-0.078	0.147	-0.071	0.110		
Income spouse	-0.027	0.030	-0.036	0.110	-0.026	0.026	0.110**	0.043
Vacancy rate	-0.001	0.005	0.012	0.012	0.015**	0.003	0.012	0.008
# households	6,104	# hh-months 427,288						

Table 8: Estimates of monthly transitions out of Employment

	men				women			
	into Unemployed search		into Nonparticipation		into Unemployed search		into Nonparticipation	
Variable	Est.	se	Est.	se	Est.	se	Est.	se
Simple model of labor market transitions								
Spouse unempl.	0.168**	0.078	0.106	0.126	0.317**	0.085	0.070	0.104
Spouse nonp.	0.030	0.039	0.050	0.053	-0.006	0.104	-0.013	0.090
Income spouse	0.040**	0.018	0.006	0.027	-0.002	0.016	0.032**	0.006
Vacancy rate	-0.013**	0.003	-0.003	0.004	-0.013**	0.003	0.002	0.002
Model of labor market transitions with unobserved heterogeneity and initial conditions								
Spouse unempl.	0.133	0.083	0.138	0.106	0.305**	0.082	0.110	0.082
Spouse nonp.	-0.022	0.049	0.008	0.049	0.065	0.089	0.045	0.069
Income spouse	0.016	0.021	-0.009	0.031	0.0002	0.019	0.035**	0.008
Vacancy rate	-0.014**	0.003	-0.002	0.004	-0.013**	0.003	0.0043**	0.0021
Model of labor market transitions with unobserved heterogeneity, flexible initial conditions								
Spouse unempl.	0.116	0.079	-0.009	0.116	0.256**	0.086	0.028	0.098
Spouse nonp.	-0.007	0.048	-0.004	0.051	0.037	0.093	0.020	0.078
Income spouse	0.023	0.021	-0.005	0.029	-0.001	0.020	0.033**	0.008
Vacancy rate	-0.014**	0.003	-0.005	0.004	-0.014**	0.003	0.002	0.002
# households	6,104	# hh-months 427,288						

Table 9: Estimates of monthly transitions out of Nonparticipation

	men				women			
	into Employment		into Unemployed Search		into Employment		into Unemployed Search	
Variable	Est.	se	Est.	se	Est.	se	Est.	se
Simple model of labor market transitions								
Spouse unempl.	-0.053	0.155	-0.012	0.410	-0.042	0.088	0.207	0.129
Spouse nonp.	-0.208**	0.102	-0.236	0.192	-0.085	0.085	-0.183	0.174
Income spouse	-0.027	0.052	0.133**	0.066	0.011	0.014	-0.004	0.022
Vacancy rate	0.003	0.007	-0.042**	0.016	0.006**	0.002	-0.002	0.004
Model of labor market transitions with unobserved heterogeneity and initial conditions								
Spouse unempl.	0.002	0.149	0.061	0.370	-0.034	0.081	0.201	0.123
Spouse nonp.	-0.136**	0.068	-0.086	0.168	-0.067	0.067	-0.214	0.159
Income spouse	0.014	0.035	0.054	0.074	0.017	0.012	-0.012	0.026
Vacancy rate	0.0093*	0.0055	-0.031*	0.017	0.0041*	0.0022	-0.0017	0.0041
Model of labor market transitions with unobserved heterogeneity, flexible initial conditions								
Spouse unempl.	0.069	0.131	-2.042	12.908	-0.009	0.082	0.204*	0.124
Spouse nonp.	-0.142*	0.078	-0.140	0.174	-0.065	0.069	-0.197	0.156
Income spouse	-0.012	0.037	0.070	0.063	0.016	0.013	-0.015	0.026
Vacancy rate	0.014**	0.006	-0.035**	0.018	0.0056**	0.0023	-0.0013	0.0041
# households	6,104	# hh-months 427,288						

Table 10: Estimates of parameters distribution unobserved heterogeneity

	men		women	
Variable	Est.	se	Est.	se
Support point ν^1	0.539**	0.073	0.337**	0.087
θ_{un}			0.900*	0.526
θ_{eu}	2.074**	0.292	2.626**	0.709
θ_{en}	1.158**	0.245	1.989**	0.553
θ_{ne}	0.959**	0.322	-1.074**	0.400
θ_{nu}	-0.416	0.607	-0.222	0.276

Parameters probabilities

	Est.	Se
Logistic $P(\nu_m = \nu_m^1, \nu_f = \nu_f^1), \rho_{11}$	-3.776	0.338
Logistic $P(\nu_m = \nu_m^1, \nu_f = \nu_f^2), \rho_{12}$	-2.641	0.224
Logistic $P(\nu_m = \nu_m^2, \nu_f = \nu_f^1), \rho_{21}$	-1.740	0.183

Probabilities

Joint	Est.	Se	Marginal	Est.	Se
$p_{11} = P(\nu_m = \nu_m^1, \nu_f = \nu_f^1)$	0.018**	0.006	$p_{1m} = P(\nu_m = \nu_m^1)$	0.076**	0.014
$p_{12} = P(\nu_m = \nu_m^1, \nu_f = \nu_f^2)$	0.056**	0.012	$p_{2m} = P(\nu_m = \nu_m^2)$	0.926**	
$p_{21} = P(\nu_m = \nu_m^2, \nu_f = \nu_f^1)$	0.138**	0.022	$p_{1f} = P(\nu_f = \nu_f^1)$	0.156**	0.023
$p_{22} = P(\nu_m = \nu_m^2, \nu_f = \nu_f^2)$	0.788**	0.024	$p_{2f} = P(\nu_f = \nu_f^2)$	0.844**	

Table 11: Estimates log hourly reservation wage of unemployed searchers

	men				women	
Variable	Est.	se	Est.	se	Est.	se
ln desired hours	-0.178**	0.054	-0.159**	0.054	-0.099**	0.048
Educ. lev. 1	-0.296**	0.060	-0.307**	0.059	-0.385**	0.107
Educ. lev. 2	-0.186**	0.060	-0.188**	0.059	-0.272**	0.107
Educ. lev. 3	-0.014	0.068	-0.015	0.068	-0.203**	0.109
No children in housh.	0.012	0.055	-0.006	0.055	-0.017	0.090
Youngest child 0-3	0.032	0.063	0.009	0.062	0.104	0.100
Youngest child 4-12	0.051	0.057	0.044	0.056	0.064	0.091
Youngest child 13-18	-0.022	0.055	-0.021	0.054	-0.078	0.088
# children above 1	0.002	0.011	0.001	0.011	-0.011	0.017
Age	0.391**	0.161	0.365**	0.160	0.438*	0.228
Age squared	-0.038**	0.019	-0.035*	0.019	-0.037	0.028
Own income	0.046**	0.023	-0.002	0.029	0.062	0.048
Own income× Spouse nonp.			0.122**	0.045		
Spouse unempl.	0.001	0.061	-0.010	0.061	0.096	0.129
Spouse nonp.	0.037	0.043	-0.059	0.056	0.117	0.094
Income spouse	0.063**	0.031	0.059*	0.031	-0.008	0.028
Birth cohort$(1950, 1965]$	-0.034	0.055	-0.025	0.055		
Birth cohort> 1965	0.056	0.094	0.063	0.093		
Birth cohort $(1950, 1960]$					0.112	0.074
Birth cohort $(1960, 1970]$					0.142	0.115
Birth cohort > 1970					0.197	0.175
Wave trend	0.003	0.003	0.002	0.003	0.006	0.005
Vacancy rate	0.002	0.002	0.002	0.002	0.000	0.003
Intercept	-4.630	6.773	-2.815	6.737	-10.597	10.577
# Observations	312		312		439	

Table 12: Poisson regressions number of applications of unemployed searchers

	men		women	
Variable	Est.	se	Est.	se
Educ. lev. 1	0.514**	0.176	0.225	0.234
Educ. lev. 2	0.474**	0.172	0.259	0.231
Educ. lev. 3	0.519**	0.180	0.296	0.238
No children in housh.	0.189	0.127	0.690**	0.251
Youngest child 0-3	0.332**	0.140	0.501**	0.273
Youngest child 4-12	0.051	0.128	0.578**	0.262
Youngest child 13-18	-0.045	0.122	0.211	0.260
# children above 1	-0.010	0.031	-0.074	0.044
Age	0.925**	0.413	-1.167**	0.469
Age squared	-0.108**	0.047	0.155**	0.056
Own income	-0.044	0.079	-0.272**	0.128
Own inc.$\times$ Sp. nonp.	-0.699**	0.132		
UI benefits as income source	0.757**	0.110	1.187**	0.105
Welfare benefits as income source	-1.440**	0.584	0.873**	0.299
Spouse unempl.	-0.171	0.141	0.401**	0.196
Spouse nonp.	0.190	0.148	-0.608*	0.328
Income spouse	0.000	0.070	-0.198**	0.070
Birth coh $(1950, 1965]$	0.311**	0.135		
Birth coh > 1965	0.003	0.229		
Birth coh $(1950, 1960]$			0.241	0.175
Birth coh $(1960, 1970]$			0.499*	0.283
Birth coh > 1970			0.140	0.422
Wave trend	0.031**	0.009	0.063**	0.014
Vacancy rate	0.011**	0.005	-0.003	0.006
Intercept	-64.4**	17.5	-125.3**	26.8
# Observations	313		527	

Table 13: Simulated transitions in a one year period (in %)

State of origin	State of destination								
	Base: average characteristics 1988-2014, trend 1988								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	2.41	4.29	72.42	0.45	1.59	17.09	0.03	0.10	1.64
uu	43.45	23.61	5.79	13.90	9.83	1.32	1.30	0.71	0.09
ue	2.50	61.03	2.74	0.70	30.22	0.90	0.05	1.79	0.06
en	0.01	0.03	0.31	1.58	6.14	91.68	0.00	0.01	0.24
eu	0.28	0.16	0.03	59.22	35.74	4.33	0.15	0.10	0.01
ee	0.02	0.32	0.01	1.61	94.28	3.52	0.00	0.23	0.01
	Period 1: average characteristics period 1988-1998, trend 1988								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	2.12	3.97	73.05	0.39	1.49	17.25	0.03	0.09	1.61
uu	43.84	22.39	6.43	14.26	9.49	1.50	1.30	0.68	0.10
ue	2.47	60.71	2.96	0.70	30.29	0.98	0.05	1.78	0.06
en	0.01	0.03	0.35	1.38	5.72	92.27	0.01	0.01	0.23
eu	0.32	0.16	0.03	60.24	34.12	4.88	0.15	0.09	0.01
ee	0.02	0.35	0.01	1.59	94.00	3.76	0.00	0.24	0.01
	Period 2: average characteristics period 2000-2014, trend 1988								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	2.51**	4.71**	70.69**	0.51*	1.89**	18.20	0.03	0.10	1.36
uu	41.61*	24.74**	5.18*	14.29	11.26**	1.21	1.00	0.62	0.08
ue	2.22**	60.12	2.25**	0.65	32.36**	0.82**	0.03	1.50	0.05
en	0.01	0.03	0.28**	1.71**	6.85**	90.89**	0.00	0.02	0.22
eu	0.26**	0.16	0.01*	57.33**	38.16**	3.85**	0.14	0.09	0.01
ee	0.02	0.30**	0.01	1.42**	94.99**	3.03**	0.00	0.22	0.01
	Trend: average characteristics 1988-2014, trend 2012								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	6.26*	6.92*	59.51**	1.81**	3.35**	19.01	0.20	0.32	2.62
uu	34.74*	25.17	5.85	14.82	14.11	1.62	2.04	1.47	0.19
ue	1.51	56.65	0.48**	0.55	37.40	0.18**	0.07	3.14	0.02
en	0.04**	0.06**	0.40	5.12**	10.37**	83.93**	0.00	0.01	0.06**
eu	0.37	0.27	0.04	52.29	42.44	4.52	0.05	0.03**	0.00
ee	0.02	0.48	0.00**	1.05	97.80**	0.58**	0.00	0.07**	0.00**

*/** indicate 10%/5% significant difference from Period 1 for Period 2 results; difference from Base for Trend results

Table 13: Simulated transitions in a one year period (in %)

State of origin	State of destination								
	High vacancy rate: av. characteristics 1988-2014, trend 1988								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	2.10	4.99*	71.79	0.38	1.79	16.41	0.03	0.18	2.33
uu	35.89**	28.97**	7.46	11.26**	11.93	1.60	1.52	1.21	0.17
ue	1.60**	61.88	2.83	0.43**	29.62	0.95	0.05	2.55	0.09
en	0.00	0.02*	0.19**	1.41	7.11**	91.05	0.00	0.01	0.19
eu	0.15**	0.12**	0.02	49.75**	44.21**	5.55	0.10	0.10	0.01
ee	0.01**	0.20**	0.01	1.02**	94.87*	3.69	0.00	0.20	0.01
	Low educ. woman: av. char. period 1988-1998, trend 1988								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	1.67	3.13	74.45	0.34	1.18	17.48	0.03	0.07	1.67
uu	46.06	18.58	8.61	14.93	7.83	1.86	1.41	0.57	0.15
ue	2.90	59.38	4.14	0.83	29.48	1.38	0.06	1.75	0.08
en	0.01	0.02	0.32	1.13	4.55	93.73	0.00	0.01	0.24
eu	0.31	0.13	0.03	64.35	28.56	6.36	0.16	0.08	0.01
ee	0.02	0.31	0.02	1.91	92.19	5.31	0.00	0.22	0.01
	High educ. woman: av. char. period 2000-2014, trend 1988								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	6.24*	8.00**	64.34**	1.34*	2.89**	15.40**	0.10	0.18	1.51
uu	36.86	32.86**	2.30*	11.55**	13.85**	0.46**	1.08	0.99*	0.04
ue	2.19	62.79**	1.12**	0.59	31.01**	0.40**	0.04	1.84	0.02*
en	0.03	0.05*	0.27**	4.53**	10.79**	84.09**	0.01	0.02*	0.22**
eu	0.23	0.21**	0.01*	48.45**	49.25**	1.60**	0.12	0.12**	0.00*
ee	0.02	0.33**	0.01**	1.36	96.56**	1.48**	0.00	0.23**	0.00**
	Childless couple: av. characteristics 1988-2014, trend 1988								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	2.51	4.84	69.38*	0.54	1.98*	18.28	0.06	0.17	2.26
uu	37.57**	25.15	7.28	13.49	11.92	1.77	1.59	1.05	0.19
ue	2.31	59.21	1.74**	0.72	32.82	0.64**	0.07	2.41	0.06
en	0.01	0.04	0.35	1.75	7.11**	90.37**	0.00	0.03**	0.34**
eu	0.29	0.19*	0.04	53.66**	39.91	5.55	0.20	0.14*	0.01
ee	0.02	0.37	0.01	1.56	95.42**	2.26**	0.01	0.34**	0.01

*/** indicate 10%/5% significant difference from Low educ. for High educ. results;
difference from Base for High vacancy rate and Childless couple results

Table 14: Simulated transitions in a one year period (in %) by unobserved heterogeneity

State of origin	State of destination								
	Support point (ν_m^1, ν_f^1) with $p_{11} = 0.02$								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	1.14*	1.09**	49.53	0.85	1.41	44.18**	0.04	0.05	1.72
uu	19.90**	15.18**	7.56	23.36**	25.08**	6.87**	0.92	0.88	0.26*
ue	7.42**	21.34**	7.90	8.43**	42.96**	9.92**	0.34	1.37	0.32**
en	0.13**	0.14*	6.58**	1.18	2.30**	87.68*	0.02	0.04	1.91**
eu	3.81**	2.98**	0.98**	39.74**	40.35*	10.25**	0.86	0.83**	0.20**
ee	1.12**	4.15**	1.19**	10.48**	64.77**	16.40**	0.26	1.31**	0.33**
	Support point (ν_m^1, ν_f^2) with $p_{12} = 0.061$								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	1.53**	2.88**	46.89**	1.23**	3.80**	41.84**	0.03	0.15	1.64
uu	27.69**	12.41**	3.20*	32.52**	19.50**	2.61**	1.31	0.66	0.09
ue	0.94**	32.14**	1.12**	0.97**	61.42**	1.42*	0.04	1.89	0.05
en	0.16**	0.43**	6.24**	1.58**	6.40**	83.21**	0.03	0.13**	1.82**
eu	5.39**	2.34**	0.37**	55.89**	30.71**	3.42**	1.13	0.68**	0.07*
ee	0.12**	5.90**	0.19**	1.01**	88.59**	2.30**	0.02	1.82**	0.05**
	Support point (ν_m^2, ν_f^1) with $p_{21} = 0.113$								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	1.86	1.86**	77.47**	0.36	0.59**	16.02**	0.03	0.05	1.76
uu	33.96**	28.04**	12.72*	9.59**	10.91**	2.65**	1.03	0.85	0.25
ue	14.01**	42.69**	13.97**	3.75**	19.52**	4.11**	0.33	1.30	0.33*
en	0.01	0.01**	0.23*	1.28	2.49**	95.77**	0.00	0.00	0.20*
eu	0.16*	0.13**	0.03	44.09**	44.17**	11.21**	0.10	0.10	0.02*
ee	0.05**	0.17**	0.04**	11.47**	70.22**	17.85**	0.03	0.15**	0.03**
	Support point (ν_m^2, ν_f^2) with $p_{22} = 0.806$								
	uu	ue	un	eu	ee	en	nu	ne	nn
un	2.58	5.01	73.29	0.43	1.64	15.18	0.03	0.14	1.68
uu	46.77	22.99	5.38	13.21	8.47	1.03	1.39	0.66	0.09
ue	1.78	64.98	2+02	0.44	28.24	0.61	0.04	1.84	0.06
en	0.01	0.03	0.22	1.70	6.97	90.88	0.00	0.01	0.19
eu	0.22	0.10	0.02	62.09	33.62	3.74	0.12	0.07	0.01
ee	0.01	0.23	0.01	1.09	95.93	2.51	0.00	0.21	0.00

*/** indicate 10%/5% significant difference from Support point (ν_m^2, ν_f^2) results;

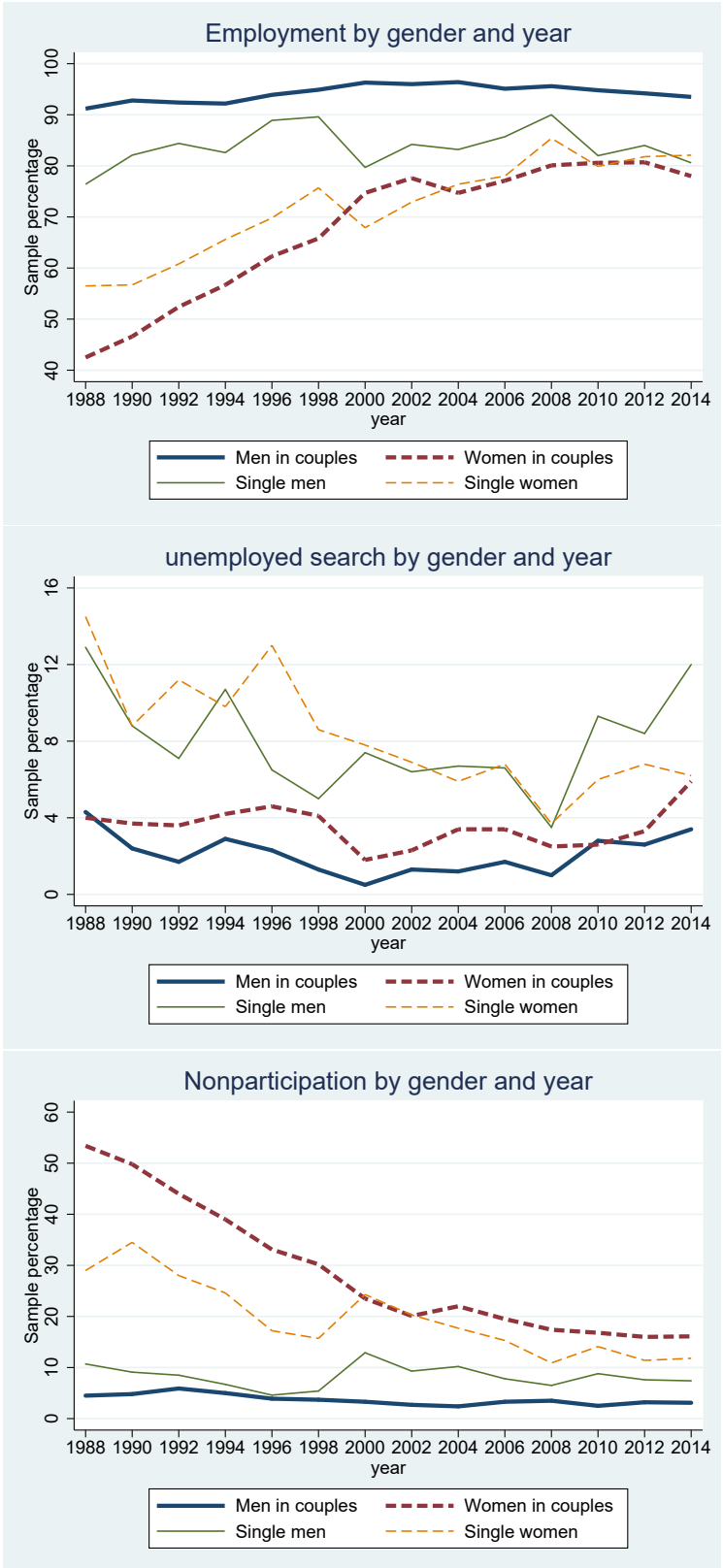

Figure 1: Labor market states by gender and year

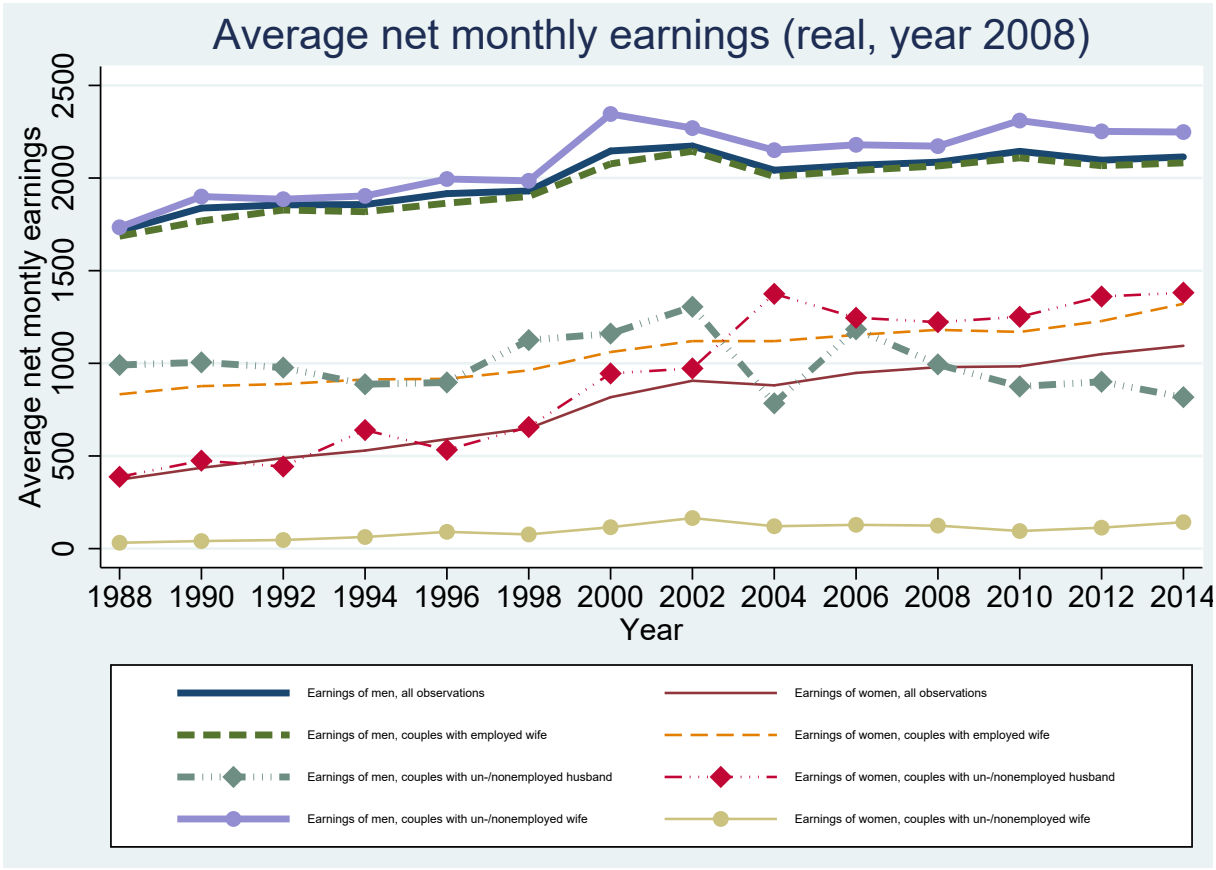

Figure 2: Average net earnings of couples

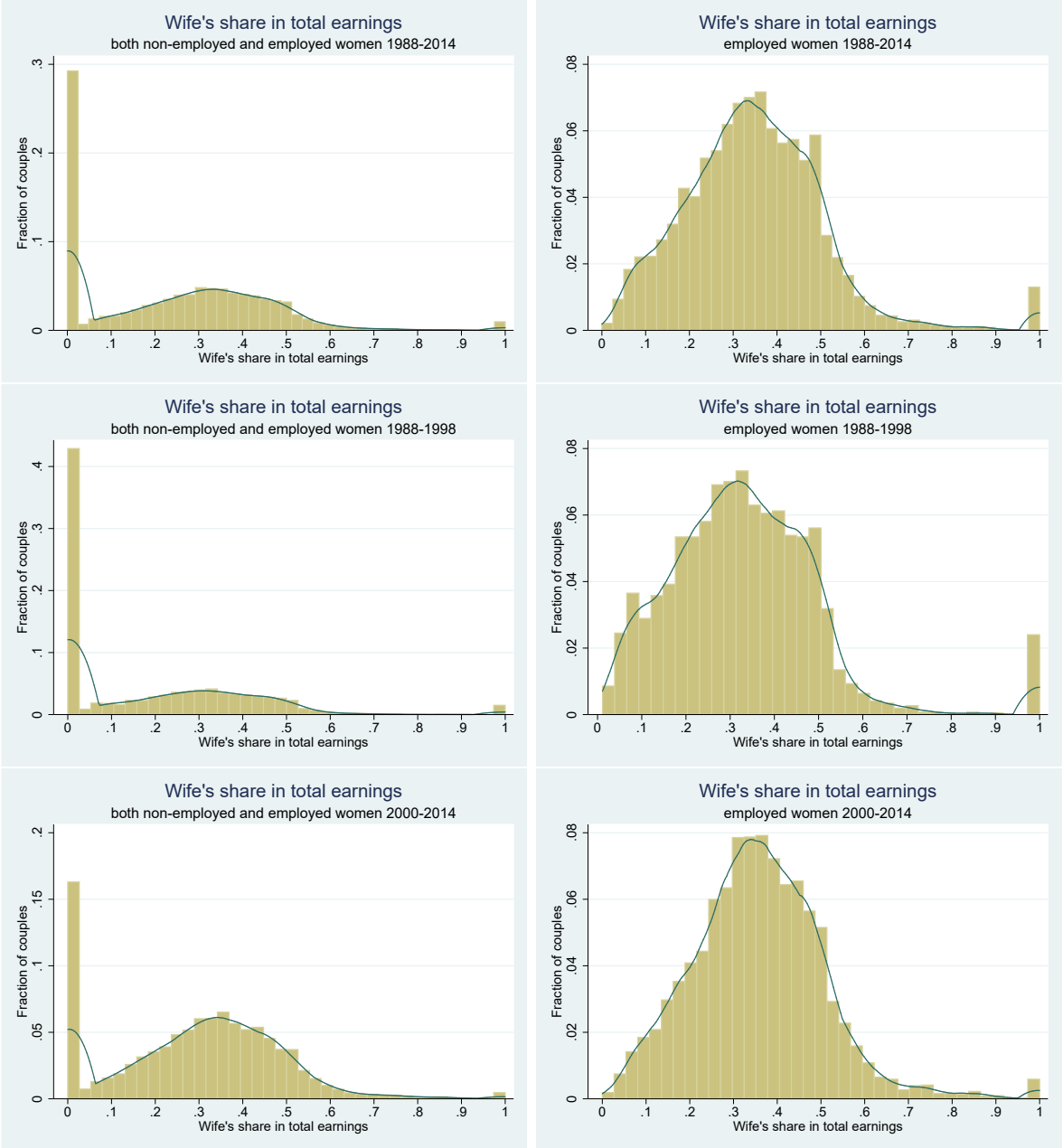

Figure 3: Women's earnings as a fraction of the sum of partners' earnings

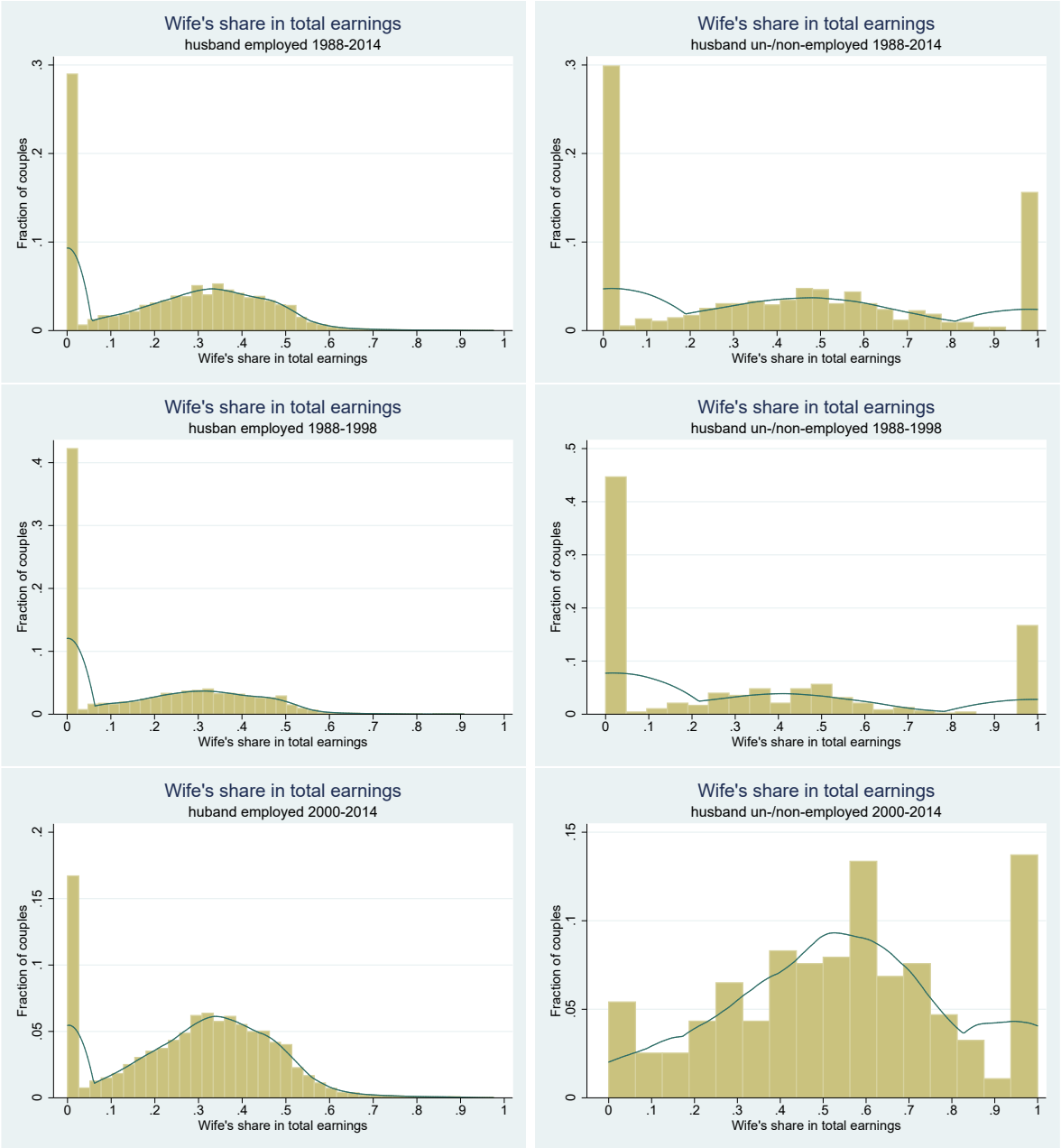

Figure 4: Women's earnings as a fraction of the sum of partners' earnings by husband's labour market state

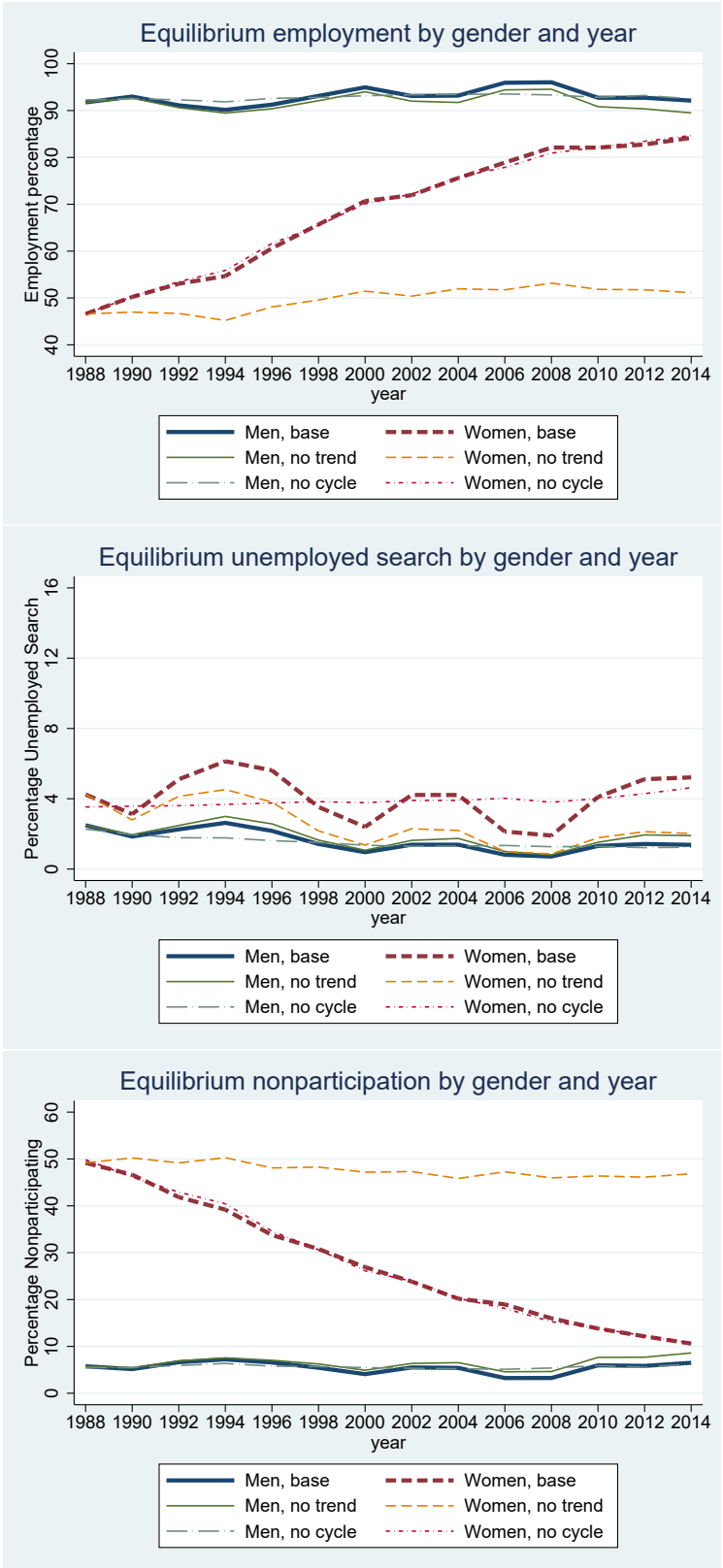

Figure 5: Labor market states by gender and year, model estimates.

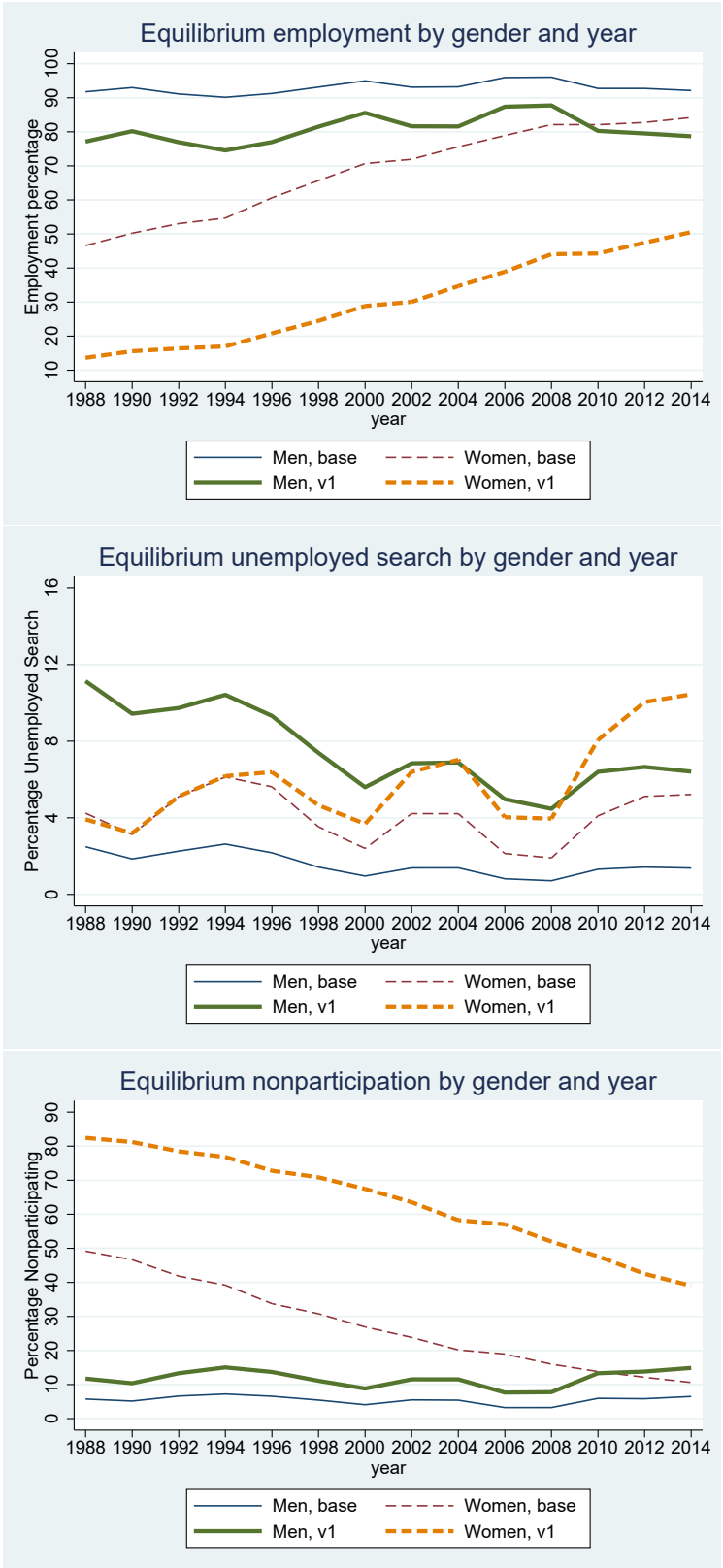

Figure 6: Labor market states by gender and year, by unobserved heterogeneity types.

A Labor market states and transition intensities

Let E, U and N denote the levels of employment, unemployment, and nonparticipation. The transition intensity from state j to state l is denoted by λ_{jl} for $l, j = e, u, n$. In equilibrium, the inflow into a labour market state equals the outflow. Thus we have the flow conditions

$$\lambda_{ue}U + \lambda_{ne}N = \lambda_{eu}E + \lambda_{en}E \tag{12}$$

$$\lambda_{eu}E + \lambda_{nu}N = \lambda_{ue}U + \lambda_{un}U \tag{13}$$

$$\lambda_{un}U + \lambda_{en}E = \lambda_{nu}N + \lambda_{ne}N \tag{14}$$

One flow equation is redundant[27] and we continue with equations (12) and (13). We divide by E and rewrite (12) and (13) in matrix notation as

$$\begin{pmatrix} \lambda_{ue} & \lambda_{ne} \\ \lambda_{ue} + \lambda_{un} & -\lambda_{nu} \end{pmatrix} \begin{pmatrix} \frac{U}{E} \\ \frac{N}{E} \end{pmatrix} = \begin{pmatrix} \lambda_{eu} + \lambda_{en} \\ \lambda_{eu} \end{pmatrix} \tag{15}$$

Inverting the matrix gives the solution

$$\begin{pmatrix} \frac{U}{E} \\ \frac{N}{E} \end{pmatrix} = \frac{1}{\det} \begin{pmatrix} -\lambda_{nu} & -\lambda_{ne} \\ -\lambda_{ue} - \lambda_{un} & \lambda_{ue} \end{pmatrix} \begin{pmatrix} \lambda_{eu} + \lambda_{en} \\ \lambda_{eu} \end{pmatrix} \tag{16}$$

with

$$A_E := -\det = \lambda_{ue}\lambda_{ne} + \lambda_{nu}\lambda_{ue} + \lambda_{un}\lambda_{ne} \tag{17}$$

Writing the solution (16) explicitly:

$$\frac{U}{E} = \frac{A_U}{A_E} \text{ with } A_U := \lambda_{eu}\lambda_{nu} + \lambda_{en}\lambda_{nu} + \lambda_{ne}\lambda_{eu} \tag{18}$$

$$\frac{N}{E} = \frac{A_N}{A_E} \text{ with } A_N := \lambda_{en}\lambda_{un} + \lambda_{eu}\lambda_{un} + \lambda_{ue}\lambda_{en} \tag{19}$$

[27] If inflows and outflows are equal for two states, it also holds for the third state.

We can use (17), (18) and (19) to write the employment rate $\bar{e}$ as

$$\bar{e} = \frac{E}{E+U+N} = \frac{1}{1+\frac{U}{E}+\frac{N}{E}} = \frac{A_E}{A_E+A_U+A_N} \tag{20}$$

Similarly, we can write the unemployment rate $\bar{u}$ and the nonparticipation rate $\bar{n}$ as

$$\bar{u} = \frac{A_U}{A_E+A_U+A_N} \text{ and } \bar{n} = \frac{A_N}{A_E+A_U+A_N} \tag{21}$$

B Probabilities for initial conditions

The probabilities for the initial labor market states (e, u, or n) need to be incorporated in the likelihood function if time-invariant unobserved heterogeneity is included.[28] This can be done in several ways. The probabilities can be specified flexibly, ignoring any parameter restrictions between the initial state probabilities and the transition probabilities. But (20) and (21) in Section A impose that the state probabilities directly depend on the transition probabilities. Ignoring any parameter restrictions between the transition probabilities and the probabilities for the initial states is inefficient but flexible, as is reflected by the additional parameters that are added to the estimation procedure. The fully flexible approach adds four parameter vectors (two for each spouse) to the estimation of the model (since there are three labor market states for each gender with probabilities adding up to one). Completely relying on the conditions (20) and (21) does not add any parameters to the model estimation in addition to the transition probabilities. In the literature of structural estimation of equilibrium search models, expressions for equilibrium states have been exploited to correct for selection (examples include Van den Berg and Ridder, 1998; Bontemps, Robin, and Van den Berg, 2000). Implementation of this practice in the present context boils down to setting λ_{rq} in section A equal to

$$\lambda_{rq} = P_r(q|x_{i,0}, q^j_{i,0}, z^l_{i,0}, \nu_{ij}), r, q \in \{e, u, n\} \tag{22}$$

[28] See Bhargava and Sargan (1983) for a general exposition on the inclusion of initial conditions in dynamic panel data models.

for spouse j in household i with characteristics observed in period 0, exploiting the empirical specification of the transition probability in equation (7), and setting the probabilities for the initial states by (20) and (21).

As an alternative, intermediate, approach we introduce a variant that combines the structure with flexibility, by allowing the solution of the equilibrium states in (16) to not hold exactly. We allow for a multiplicative deviation in (17) and replace $-\det$ in (17) by $-\det \times(1+\epsilon)$, with ϵ the Gaussian error function. For spouse j in household i the specification of the Gaussian error function is

$$\epsilon_{ij} = 2\Phi\left(\sqrt{2}\left[(x'_{i0}, q^{j'}_{i,0}, z^{l'}_{i,0})\delta_j + \theta_{dj}\nu_{ij}\right]\right) - 1 \tag{23}$$

with $\Phi(.)$ the standard normal distribution function. A property of the Gaussian error function is that $\epsilon_{ij} \in (-1, 1)$, such that $1+\epsilon_{ij} \in (0, 2)$. In (23) $\delta_j, j = m, f$ is a parameter vector measuring the impact of the covariates and θ_{dj} is the parameter measuring the unobservable. The structural rates (20) and (21) are nested, since they prevail if $\delta_j \equiv 0$ and $\theta_{dj} = 0$. The specification adds two additional parameter vectors ($(\delta'_j, \theta_{dj})'$, one for each spouse) measuring deviations from the equilibrium states. Thus, we still exploit the structure of the equilibrium states, but we allow for more flexibibility (since a fully flexible specification would add four parameter vectors, while completely relying on the equilibrium states would not add any additional parameters). Moreover, the parameters δ_j and θ_{dj} are interpretable. A positive (negative) value of parameter δ_{jk} means that the corresponding covariate makes the probability to be found in the state of employment bigger (smaller) than could be expected on basis of the inflow-equals-outflow conditions (12) through (14), relative to the other states.

C Results simple model labor market transitions

Estimaton results of model of labor market transitions without unobserved heterogeneity in Tables C1 through C6.

Table C1: Estimates of monthly transitions of men out of Unemployed Search

	into Employment		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.048	0.109	0.221	0.244
Educ. lev. 2	-0.023	0.102	0.318	0.252
Educ. lev. 3	0.115	0.122		
No children in housh.	0.027	0.115	0.240	0.149
Youngest child 0-3	0.027	0.129		
Youngest child 4-12	0.029	0.120		
Youngest child 13-18	0.039	0.117		
# children above 1	-0.007	0.026		
Age	-0.306	0.299	2.067**	1.027
Age squared	0.005	0.037	-0.188*	0.111
Wife unempl.	-0.221*	0.130		
Wife nonp.	-0.274**	0.069	-0.090	0.153
Income wife	-0.070**	0.036	-0.130	0.095
Birth cohort$(1950, 1965]$	-0.216	0.115	0.470*	0.273
Birth cohort>1965	-0.191	0.192	0.848	0.531
Wave trend	0.016**	0.007	-0.036*	0.019
Vacancy rate	0.0004	0.005	0.017	0.013
Intercept	-0.337	0.613	-8.514**	2.441

Table C2: Estimates of monthly transitions of men out of Employment

	into Unemployed search		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	0.073	0.064	0.125	0.104
Educ. lev. 2	-0.030	0.067	0.140	0.107
Educ. lev. 3	-0.152**	0.071	-0.071	0.112
No children in housh.	-0.011	0.067	0.063	0.067
Youngest child 0-3	-0.078	0.079	0.003	0.110
Youngest child 4-12	-0.003	0.074	-0.020	0.092
Youngest child 13-18	-0.066	0.068	-0.126	0.079
# children above 1	-0.008	0.018	-0.009	0.025
Age	-0.356	0.228	-1.529**	0.340
Age squared	0.036	0.027	0.202**	0.038
Wife unempl.	0.168**	0.078	0.106	0.126
Wife nonp.	0.030	0.039	0.050	0.053
Income wife	0.040**	0.018	0.006	0.027
Birth cohort$(1950, 1965]$	-0.023	0.066	-0.099	0.086
Birth cohort>1965	-0.104	0.117	-0.238	0.173
Wave trend	0.012**	0.004	-0.010*	0.006
Vacancy rate	-0.013**	0.003	-0.003	0.004
Intercept	-2.161**	0.476	-0.557	0.783

Table C3: Estimates of monthly transitions of men out of Nonparticipation

	into Employment		into Unemployed search	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.379**	0.135	-0.145	0.253
Educ. lev. 2	-0.150	0.131	-0.128	0.256
Educ. lev. 3	-0.401**	0.122	-0.163	0.257
No children in housh.	0.011	0.205	0.083	0.148
Youngest child 0-3	0.078	0.233		
Youngest child 4-12	0.065	0.232		
Youngest child 13-18	0.086	0.222		
# children above 1	-0.056	0.044		
Age	-1.176**	0.495	0.226	0.718
Age squared	0.081	0.061	-0.059	0.091
Wife unempl.	-0.053	0.155	-0.012	0.410
Wife nonp.	-0.208**	0.102	-0.236	0.192
Income wife	-0.027	0.052	0.133**	0.066
Birth cohort$(1950, 1965]$	0.128	0.168	0.409	0.406
Birth cohort>1965	-0.222	0.293	0.270	0.627
Wave trend	-0.001	0.009	0.000	0.019
Vacancy rate	0.003	0.007	-0.042**	0.016
Intercept	1.291	1.016	-2.527	1.567

Table C4: Estimates of monthly transitions of women out of Unemployed Search

	into Employment		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.349**	0.106	0.404**	0.158
Educ. lev. 2	-0.165	0.103	0.364**	0.151
Educ. lev. 3	-0.024	0.105		
No children in housh.	0.060	0.134	-0.005	0.180
Youngest child 0-3	-0.336**	0.139	0.122	0.200
Youngest child 4-12	-0.119	0.128	-0.183	0.187
Youngest child 13-18	0.113	0.129	-0.273	0.192
# children above 1	-0.028	0.024	-0.026	0.053
Age	0.261	0.280	-0.271	0.517
Age squared	-0.070**	0.036	0.031	0.067
Husband unempl.	-0.064	0.115	0.287	0.189
Husband nonp.	-0.067	0.131		
Income husband	-0.028	0.025	0.080*	0.046
Birth cohort $(1950, 1960]$	-0.047	0.089	0.018	0.165
Birth cohort $(1960, 1970]$	-0.145	0.138	-0.181	0.257
Birth cohort > 1970	-0.212	0.216	-0.052	0.413
Wave trend	0.013*	0.007	0.005	0.014
Vacancy rate	0.014**	0.004	0.010	0.007
Intercept	-1.544**	0.590	-2.538**	1.035

Table C5: Estimates of monthly transitions of women out of Employment

	into Unemployed search		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.047	0.074	0.310**	0.081
Educ. lev. 2	-0.072	0.070	0.163**	0.080
Educ. lev. 3	-0.068	0.069	-0.022	0.085
No children in housh.	0.085	0.077	0.026	0.076
Youngest child 0-3	0.080	0.084	0.496**	0.080
Youngest child 4-12	0.094	0.080	0.244**	0.080
Youngest child 13-18	0.077	0.077	0.081	0.075
# children above 1	-0.001	0.017	-0.014	0.016
Age	-0.233	0.214	-0.988**	0.181
Age squared	0.008	0.027	0.117**	0.023
Husband unempl.	0.317**	0.085	0.070	0.104
Husband nonp.	-0.006	0.104	-0.013	0.090
Income husband	-0.002	0.016	0.032**	0.006
Birth cohort $(1950, 1960]$	-0.136*	0.082	-0.063	0.070
Birth cohort $(1960, 1970]$	-0.230**	0.116	-0.065	0.100
Birth cohort > 1970	-0.362**	0.166	-0.099	0.142
Wave trend	0.013**	0.006	-0.017**	0.005
Vacancy rate	-0.013**	0.003	0.002	0.002
Intercept	-28.7**	10.8	32.2**	9.3

Table C6: Estimates of monthly transitions of women out of Nonparticipation

	into Employment		into Unemployed Search	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.283**	0.085	-0.487**	0.122
Educ. lev. 2	-0.162*	0.085	-0.354**	0.118
Educ. lev. 3	-0.093	0.089	-0.186	0.124
No children in housh.	-0.091	0.072	0.061	0.133
Youngest child 0-3	-0.343**	0.078	-0.165	0.141
Youngest child 4-12	-0.094	0.072	0.096	0.129
Youngest child 13-18	0.007	0.068	0.024	0.128
# children above 1	0.013	0.011	-0.013	0.019
Age	-0.065	0.173	0.348	0.320
Age squared	-0.039*	0.022	-0.075*	0.041
Husband unempl.	-0.042	0.088	0.207	0.129
Husband nonp.	-0.085	0.085	-0.183	0.174
Income husband	0.011	0.014	-0.004	0.022
Birth cohort $(1950, 1960]$	0.017	0.063	-0.116	0.120
Birth cohort $(1960, 1970]$	-0.050	0.095	-0.167	0.176
Birth cohort > 1970	-0.185	0.145	-0.045	0.257
Wave trend	0.012**	0.005	0.021**	0.008
Vacancy rate	0.006**	0.002	-0.002	0.004
Intercept	-1.557**	0.360	-2.847**	0.652

D Results model labor market transitions, including unobserved heterogeneity and initial conditions

Estimaton results of model of labor market transitions with unobserved heterogeneity and initial conditions in Tables D1 through D6. Probabilities for initial labor market states are based on transition probabilities by equating flows into and out of states, as described in section B.

Table D1: Estimates of monthly transitions of men out of Unemployed Search

	into Employment		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.022	0.098	0.361	0.242
Educ. lev. 2	0.015	0.097	0.364	0.244
Educ. lev. 3	0.078	0.111		
No children in housh.	-0.069	0.108	0.175	0.158
Youngest child 0-3	-0.184	0.118		
Youngest child 4-12	-0.129	0.109		
Youngest child 13-18	-0.098	0.103		
# children above 1	0.008	0.023		
Age	-0.386	0.275	2.169**	1.062
Age squared	0.016	0.034	-0.217**	0.120
Wife unempl.	-0.233**	0.103		
Wife nonp.	-0.269**	0.060	-0.052	0.146
Income wife	-0.014	0.031	-0.011	0.116
Birth cohort$(1950, 1965]$	-0.193**	0.099	0.415	0.253
Birth cohort>1965	-0.201	0.164	0.655	0.452
Wave trend	0.015**	0.006	-0.019	0.017
Vacancy rate	-0.003	0.004	0.012	0.011
Intercept	-0.388	0.572	-8.614	2.403

Table D2: Estimates of monthly transitions of men out of Employment

	into Unemployed search		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	0.091	0.071	-0.132*	0.080
Educ. lev. 2	-0.029	0.071	-0.111	0.078
Educ. lev. 3	-0.140*	0.078	-0.211**	0.085
No children in housh.	-0.050	0.072	0.012	0.069
Youngest child 0-3	-0.103	0.083	-0.096	0.092
Youngest child 4-12	-0.032	0.077	-0.109	0.090
Youngest child 13-18	-0.050	0.071	-0.149*	0.086
# children above 1	-0.025	0.017	-0.009	0.022
Age	-0.682**	0.227	-2.219**	0.233
Age squared	0.073**	0.027	0.271**	0.029
Wife unempl.	0.133	0.083	0.137	0.105
Wife nonp.	-0.016	0.049	0.011	0.049
Income wife	0.015	0.021	-0.008	0.030
Birth cohort$(1950, 1965]$	-0.055	0.076	-0.108	0.080
Birth cohort>1965	-0.168	0.127	-0.289**	0.136
Wave trend	0.011**	0.005	-0.008*	0.005
Vacancy rate	-0.014**	0.003	-0.002	0.004
Intercept	-1.636**	0.476	1.235**	0.480

Table D3: Estimates of monthly transitions of men out of Nonparticipation

	into Employment		into Unemployed search	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.384**	0.118	0.349	0.304
Educ. lev. 2	-0.215*	0.121	0.240	0.320
Educ. lev. 3	-0.288**	0.123	-0.081	0.330
No children in housh.	-0.026	0.096	0.053	0.198
Youngest child 0-3	0.019	0.136		
Youngest child 4-12	-0.084	0.122		
Youngest child 13-18	-0.175	0.108		
# children above 1	-0.012	0.029		
Age	-1.039**	0.350	-0.320	1.041
Age squared	0.096**	0.042	-0.013	0.145
Wife unempl.	0.014	0.146	0.067	0.353
Wife nonp.	-0.140	0.068	-0.087	0.164
Income wife	0.013	0.035	0.052	0.073
Birth cohort$(1950, 1965]$	-0.037	0.130	0.180	0.518
Birth cohort>1965	-0.305	0.219	0.054	0.641
Wave trend	-0.006	0.007	-0.013	0.016
Vacancy rate	0.010*	0.006	-0.033**	0.016
Intercept	0.446	0.721	-1.211	1.725

Table D4: Estimates of monthly transitions of women out of Unemployed Search

	into Employment		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.200**	0.090	0.430**	0.151
Educ. lev. 2	-0.068	0.087	0.314**	0.151
Educ. lev. 3	0.052	0.091		
No children in housh.	0.046	0.107	-0.035	0.176
Youngest child 0-3	-0.226*	0.116	0.024	0.203
Youngest child 4-12	-0.062	0.108	-0.278	0.190
Youngest child 13-18	0.105	0.106	-0.331	0.198
# children above 1	-0.025	0.021	0.004	0.050
Age	0.118	0.235	0.130	0.517
Age squared	-0.042	0.031	-0.016	0.067
Husband unempl.	-0.074	0.107	0.323	0.188
Husband nonp.	-0.083	0.111		
Income husband	-0.023	0.026	0.104**	0.043
Birth cohort $(1950, 1960]$	-0.041	0.077	0.076	0.161
Birth cohort $(1960, 1970]$	-0.091	0.120	-0.071	0.266
Birth cohort > 1970	-0.096	0.187	0.094	0.402
Wave trend	0.008	0.006	-0.0002	0.014
Vacancy rate	0.014	0.003	0.012	0.008
Intercept	-1.693	0.478	-3.484**	1.072

Table D5: Estimates of monthly transitions of women out of Employment

	into Unemployed search		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.002	0.072	0.244**	0.067
Educ. lev. 2	-0.061	0.070	0.106	0.066
Educ. lev. 3	-0.111	0.072	-0.091	0.069
No children in housh.	0.052	0.076	-0.055	0.064
Youngest child 0-3	0.092	0.083	0.369**	0.068
Youngest child 4-12	0.118	0.079	0.239**	0.064
Youngest child 13-18	0.073	0.074	0.077	0.062
# children above 1	0.005	0.017	0.030**	0.011
Age	-0.416**	0.190	-0.934**	0.146
Age squared	0.032	0.024	0.101**	0.019
Husband unempl.	0.307*	0.082	0.123	0.082
Husband nonp.	0.061	0.089	0.051	0.069
Income husband	-0.002	0.020	0.036**	0.008
Birth cohort $(1950, 1960]$	-0.076	0.070	-0.092**	0.050
Birth cohort $(1960, 1970]$	-0.249**	0.103	-0.161**	0.075
Birth cohort > 1970	-0.359**	0.154	-0.149	0.111
Wave trend	0.008	0.005	-0.020**	0.004
Vacancy rate	-0.013**	0.003	0.0047**	0.0021
Intercept	-1.732**	0.399	-1.068**	0.306

Table D6: Estimates of monthly transitions of women out of Nonparticipation

	into Employment		into Unemployed Search	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.185**	0.094	-0.472**	0.117
Educ. lev. 2	-0.068	0.093	-0.338**	0.115
Educ. lev. 3	0.000	0.096	-0.173	0.118
No children in housh.	0.034	0.062	0.094	0.127
Youngest child 0-3	-0.249**	0.068	-0.032	0.138
Youngest child 4-12	-0.048	0.063	0.163	0.127
Youngest child 13-18	0.042	0.060	0.065	0.126
# children above 1	-0.016	0.011	-0.040**	0.020
Age	-0.182	0.154	0.395	0.304
Age squared	-0.020	0.020	-0.083**	0.039
Husband unempl.	-0.040	0.081	0.191	0.123
Husband nonp.	-0.072	0.067	-0.221	0.159
Income husband	0.016	0.012	-0.013	0.026
Birth cohort $(1950, 1960]$	0.017	0.053	-0.160	0.099
Birth cohort $(1960, 1970]$	0.001	0.081	-0.249	0.151
Birth cohort > 1970	-0.170	0.123	-0.200	0.224
Wave trend	0.016**	0.004	0.026**	0.008
Vacancy rate	0.0040*	0.0022	-0.0021	0.0041
Intercept	-1.472**	0.319	-2.885**	0.595

E Results model labor market transitions, including unobserved heterogeneity and flexible initial conditions

Estimation results for the model of labor market transitions with unobserved heterogeneity and the more flexible initial conditions for labor market states in Tables E1 through E8. The basis for the probabilities of the initial states is the condition that equates flows into and out of states, but the probabilities can deviate from that by the Gaussian error function (23), section B. If the entire coefficient vector in (23) were zero, there is no difference with the model where flows into and out of states are equal. For a positive (negative) coefficient of a variable in the error function the probability to be employed for this variable is higher (lower) than can be expected on basis of equating flows into and out of states.

The main aim of estimating this variant is allowing for more flexibility to make sure that the estimates of the transition probabilities are not dominated by the equal inflow and outflow conditions. Tables 7-9 show that parameters of interest are not severely affected by making the specification more flexible. The parameter estimates of the error function are in Table E7. Interestingly, spousal unemployed search goes together with a lower probability that men are employed than can expected on basis of their transitions. The lower educated (both men and women) have a higher probability to be found in the state of employment than could be expected on basis of their transition probabilities. The same holds for women without any and with younger children compared to women with older children (the reference group). The negative effect of the vacancy rate is interpretable. With many vacancies, more transitions take place so computing state probabilities on basis of transition rates gives an overestimate of being in the state of employment. The negative parameter estimate of the error function corrects for that in downward direction.

Table E1: Estimates of monthly transitions of men out of Unemployed Search

	into Employment		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.139	0.098	0.304	0.240
Educ. lev. 2	-0.086	0.097	0.298	0.243
Educ. lev. 3	0.059	0.110		
No children in housh.	-0.093	0.111	0.176	0.158
Youngest child 0-3	-0.183	0.121		
Youngest child 4-12	-0.145	0.113		
Youngest child 13-18	-0.123	0.107		
# children above 1	0.006	0.023		
Age	-0.823**	0.282	2.060*	1.075
Age squared	0.064*	0.035	-0.204*	0.122
Wife unempl.	-0.178	0.106		
Wife nonp.	-0.291	0.062	-0.080	0.147
Income wife	-0.020	0.030	-0.034	0.106
Birth cohort$(1950, 1965]$	-0.213**	0.101	0.459*	0.247
Birth cohort>1965	-0.246	0.168	0.686	0.455
Wave trend	0.015**	0.006	-0.021	0.017
Vacancy rate	-0.002	0.005	0.013	0.011
Intercept	0.630	0.583	-8.350**	2.416

Table E2: Estimates of monthly transitions of men out of Employment

	into Unemployed search		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	0.195**	0.075	-0.013	0.084
Educ. lev. 2	0.069	0.075	0.017	0.083
Educ. lev. 3	-0.098	0.081	-0.188**	0.092
No children in housh.	-0.041	0.073	0.046	0.069
Youngest child 0-3	-0.086	0.083	-0.052	0.095
Youngest child 4-12	-0.020	0.077	-0.065	0.090
Youngest child 13-18	-0.046	0.072	-0.123	0.084
# children above 1	-0.026	0.017	-0.017	0.023
Age	-0.343	0.216	-1.636**	0.242
Age squared	0.037	0.026	0.211**	0.029
Wife unempl.	0.113	0.079	-0.014	0.116
Wife nonp.	-0.001	0.048	-0.002	0.051
Income wife	0.021	0.021	-0.004	0.028
Birth cohort$(1950, 1965]$	-0.052	0.075	-0.093	0.082
Birth cohort>1965	-0.131	0.126	-0.196	0.143
Wave trend	0.010**	0.005	-0.007	0.005
Vacancy rate	-0.014**	0.003	-0.005	0.004
Intercept	-2.507**	0.457	-0.212	0.511

Table E3: Estimates of monthly transitions of men out of Nonparticipation

	into Employment		into Unemployed search	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.314**	0.130	-0.280	0.261
Educ. lev. 2	-0.162	0.132	-0.310	0.273
Educ. lev. 3	-0.337**	0.147	-0.184	0.265
No children in housh.	-0.059	0.113	0.260	0.172
Youngest child 0-3	0.079	0.142		
Youngest child 4-12	-0.007	0.130		
Youngest child 13-18	-0.153	0.119		
# children above 1	-0.028	0.031		
Age	-1.930**	0.345	0.405	0.764
Age squared	0.184**	0.042	-0.059	0.093
Wife unempl.	0.084	0.131	-2.049	12.724
Wife nonp.	-0.139*	0.077	-0.167	0.175
Income wife	-0.011	0.037	0.070	0.064
Birth cohort$(1950, 1965]$	-0.049	0.142	0.315	0.369
Birth cohort> 1965	-0.406*	0.228	0.325	0.539
Wave trend	-0.006	0.007	-0.015	0.016
Vacancy rate	0.014**	0.006	-0.037**	0.018
Intercept	2.434**	0.716	-2.962**	1.579

Table E4: Estimates of monthly transitions of women out of Unemployed Search

	into Employment		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.302**	0.087	0.444**	0.151
Educ. lev. 2	-0.158*	0.084	0.331**	0.151
Educ. lev. 3	-0.017	0.088		
No children in housh.	-0.034	0.108	-0.026	0.176
Youngest child 0-3	-0.352	0.116	0.048	0.202
Youngest child 4-12	-0.103	0.108	-0.269	0.192
Youngest child 13-18	0.087	0.106	-0.315	0.199
# children above 1	-0.005	0.021	-0.013	0.049
Age	0.004	0.238	0.218	0.514
Age squared	-0.034	0.031	-0.029	0.067
Husband unempl.	-0.041	0.105	0.331*	0.187
Husband nonp.	-0.070	0.110		
Income husband	-0.025	0.026	0.109**	0.043
Birth cohort $(1950, 1960]$	-0.050	0.076	0.079	0.161
Birth cohort $(1960, 1970]$	-0.116	0.119	-0.075	0.265
Birth cohort > 1970	-0.121	0.185	0.076	0.403
Wave trend	0.009	0.006	0.001	0.014
Vacancy rate	0.015**	0.003	0.013	0.008
Intercept	-1.222**	0.481	-3.660**	1.063

Table E5: Estimates of monthly transitions of women out of Employment

	into Unemployed search		into Nonparticipation	
Variable	Est.	se	Est.	se
Educ. lev. 1	0.080	0.079	0.394**	0.081
Educ. lev. 2	0.020	0.076	0.244**	0.080
Educ. lev. 3	-0.046	0.078	0.012	0.083
No children in housh.	0.109	0.078	0.072	0.070
Youngest child 0-3	0.173**	0.086	0.545**	0.075
Youngest child 4-12	0.123	0.082	0.265**	0.074
Youngest child 13-18	0.081	0.077	0.081	0.072
# children above 1	-0.018	0.017	-0.006	0.014
Age	-0.252	0.199	-0.750	0.175
Age squared	0.019	0.025	0.092	0.022
Husband unempl.	0.257**	0.086	0.044	0.097
Husband nonp.	0.029	0.094	0.020	0.078
Income husband	-0.004	0.020	0.033**	0.008
Birth cohort $(1950, 1960]$	-0.035	0.072	-0.033	0.060
Birth cohort $(1960, 1970]$	-0.187*	0.107	-0.070	0.090
Birth cohort > 1970	-0.279*	0.160	-0.037	0.130
Wave trend	0.007	0.005	-0.021**	0.004
Vacancy rate	-0.014**	0.003	0.002	0.002
Intercept	-2.279**	0.421	-1.840**	0.373

Table E6: Estimates of monthly transitions of women out of Nonparticipation

	into Employment		into Unemployed Search	
Variable	Est.	se	Est.	se
Educ. lev. 1	-0.272**	0.094	-0.517**	0.120
Educ. lev. 2	-0.149	0.093	-0.376**	0.117
Educ. lev. 3	-0.057	0.097	-0.204*	0.121
No children in housh.	-0.055	0.066	0.067	0.129
Youngest child 0-3	-0.371**	0.072	-0.069	0.138
Youngest child 4-12	-0.084	0.067	0.149	0.128
Youngest child 13-18	0.031	0.064	0.055	0.126
# children above 1	0.006	0.012	-0.034*	0.020
Age	-0.284*	0.165	0.348	0.308
Age squared	-0.015	0.021	-0.080**	0.040
Husband unempl.	-0.011	0.082	0.194	0.124
Husband nonp.	-0.067	0.069	-0.203	0.156
Income husband	0.015	0.013	-0.016	0.026
Birth cohort $(1950, 1960]$	-0.005	0.056	-0.169*	0.101
Birth cohort $(1960, 1970]$	-0.035	0.084	-0.265*	0.153
Birth cohort > 1970	-0.214*	0.127	-0.222	0.225
Wave trend	0.016**	0.004	0.027**	0.007
Vacancy rate	0.0056**	0.0023	-0.0016	0.0041
Intercept	-1.050**	0.339	-2.695**	0.599

Table E7: Estimates of parameters error function initial conditions

	men		women	
Variable	Est.	se	Est.	se
Educ. lev. 1	0.920**	0.169	0.792**	0.150
Educ. lev. 2	0.882**	0.166	0.670**	0.146
Educ. lev. 3	0.244	0.150	0.420**	0.148
No children in housh.	0.209	0.144	1.327**	0.256
Youngest child 0-3			1.527**	0.240
Youngest child 4-12			0.631**	0.216
Youngest child 13-18			0.240	0.209
# children above 1			-0.185**	0.039
Age	-0.356	1.368	0.514	0.568
Age squared	0.248	0.245	0.031	0.073
Spouse unempl.	-0.405**	0.158	-0.265	0.174
Spouse nonp.	0.151	0.128	-0.081	0.169
Income spouse	-0.077	0.055	0.001	0.034
Birth cohort$(1950, 1965]$	0.461	0.360		
Birth cohort> 1965	0.561	0.416		
Birth cohort $(1950, 1960]$			0.191	0.137
Birth cohort $(1960, 1970]$			0.236	0.209
Birth cohort > 1970			0.354	0.312
Wave trend	0.031**	0.013	-0.014	0.010
Vacancy rate	-0.029**	0.011	-0.011*	0.006
Intercept	-2.449	1.831	-3.728***	1.193

Table E8: Estimates of parameters distribution unobserved heterogeneity for variant with flexible initial conditions

	men		women	
Variable	Est.	se	Est.	se
Support point ν^1	0.554**	0.076	0.299**	0.081
θ_{un}			0.923	0.576
θ_{eu}	2.007**	0.298	3.126**	0.883
θ_{en}	1.169**	0.231	2.442**	0.716
θ_{ne}	0.787**	0.291	-1.108**	0.461
θ_{nu}	-0.144	0.512	-0.334	0.330
θ_d	0.170	0.397	1.312	0.845

Parameters probabilities		
	Est.	Se
Logistic $P(\nu_m = \nu_m^1, \nu_f = \nu_f^1), \rho_{11}$	-3.648**	0.309
Logistic $P(\nu_m = \nu_m^1, \nu_f = \nu_f^2), \rho_{12}$	-2.558**	0.213
Logistic $P(\nu_m = \nu_m^2, \nu_f = \nu_f^1), \rho_{21}$	-1.875**	0.202

Probabilities					
Joint	Est.	Se	Marginal	Est.	Se
$p_{11} = P(\nu_m = \nu_m^1, \nu_f = \nu_f^1)$	0.021**	0.006	$p_{1m} = P(\nu_m = \nu_m^1)$	0.082**	0.014
$p_{12} = P(\nu_m = \nu_m^1, \nu_f = \nu_f^2)$	0.062**	0.012	$p_{2m} = P(\nu_m = \nu_m^2)$	0.918**	
$p_{21} = P(\nu_m = \nu_m^2, \nu_f = \nu_f^1)$	0.122**	0.022	$p_{1f} = P(\nu_f = \nu_f^1)$	0.143**	0.022
$p_{22} = P(\nu_m = \nu_m^2, \nu_f = \nu_f^2)$	0.796**	0.024	$p_{2f} = P(\nu_f = \nu_f^2)$	0.857**	

F Sensitivity analysis with additional spousal regressors in simple model

Table F1: Estimates of monthly transitions out of Unemployed Search

	men				women			
	into Employment		into Nonparticipation		into Employment		into Nonparticipation	
Variable	Est.	se	Est.	se	Est.	se	Est.	se
Spouse unempl.	-0.213*	0.129			-0.077	0.117	0.301	0.186
Spouse nonp.	-0.254**	0.071	-0.073	0.164	-0.067	0.133		
Income spouse	-0.079**	0.037	-0.134	0.092	-0.024	0.027	0.132**	0.050
Vacancy rate	0.0002	0.005	0.018	0.013	0.015**	0.004	0.010	0.007

Table F2: Estimates of monthly transitions out of Employment

	men				women			
	into Unemployed search		into Nonparticipation		into Unemployed search		into Nonparticipation	
Variable	Est.	se	Est.	se	Est.	se	Est.	se
Spouse unempl.	0.153*	0.081	0.103	0.125	0.318**	0.085	0.046	0.106
Spouse nonp.	0.031	0.039	0.041	0.052	-0.007	0.105	-0.025	0.091
Income spouse	0.033*	0.018	0.013	0.028	-0.0002	0.016	0.033**	0.006
Vacancy rate	-0.013**	0.003	-0.003	0.004	-0.013**	0.003	0.002	0.002

Table F3: Estimates of monthly transitions out of Nonparticipation

	men				women			
	into Employment		into Unemployed Search		into Employment		into Unemployed Search	
Variable	Est.	se	Est.	se	Est.	se	Est.	se
Spouse unempl.	-0.046	0.172	0.118	0.415	-0.024	0.090	0.209	0.134
Spouse nonp.	-0.233**	0.109	-0.150	0.217	-0.082	0.086	-0.162	0.176
Income spouse	-0.002	0.052	0.147**	0.068	0.004	0.016	-0.021	0.029
Vacancy rate	0.002	0.007	-0.034**	0.015	0.006**	0.002	-0.003	0.004

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