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Stephane Gregoir & Tristan-Pierre Maury

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Stéphane Gregoir & Tristan-Pierre Maury*

EDHEC Business School - Research Centre in Economics

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Abstract

Disability has consequences on the dynamic changes in the positions on the labour and housing markets that may be magnifying each other. We estimate the share in the gap in labour force participation between able-bodied and disabled people that can be attributed to differences in individual home tenure histories. Based on an original multivariate dynamic panel data model relying on BHPS data from 1992 to 2008 and sequential estimation of two models related on the one hand to individual annual transition probabilities on the labour and housing markets and on the other hand to transition probabilities regarding health, we show that some of the medium run (between 5 and 8 years) decrease in employment probability for the disabled can be attributed to a *negative social housing sector channel*. The discrimination effect on employment for disabled people cumulates with a lower probability of participating in the job market when living in the public housing sector.

A Introduction

The differences in labour market outcomes between disabled and able-bodied people has been largely debated. Differentials in labour force participation or wages between persons with and without disability are empirically well-established. The respective roles of unobserved productivity gaps between able-bodied and disabled, and of possible discrimination effects against disabled have been quantitatively assessed in different empirical papers based generally on US or UK data. Our aim is to propose an extension of this literature toward one possibly important dimension that remained mostly unexplored at this stage: the role of home tenure.

Building on the seminal papers of Baldwin and Johnson (1994, 1995) and in line with other similar contributions

*EDHEC Business School, Economics Research Centre. Email: tristan.maury@edhec.edu

on US data (DeLeire, 2000, or Acemoglu and Angrist, 2001), Kidd *et al.* (2000) found evidence of significant wages and labour force participation rates discrepancies between able-bodied and disabled men using the British Labour Force Survey (LFS hereafter) in 1996. They adopt an econometric setup correcting for sample selectivity in human capital (people with a low educational level are more likely to have a job with high exposure to work-related disability). Such a reverse causality effect could lead to an overestimation in absolute value of the negative impact of disability on labour market participation. In their estimates, about half of the labour market outcomes differences remained unexplained, potentially giving room to the implementation of discrimation-targeted new disability rules. Though not precisely dealing with the impact of disability, Contoyannis and Rice (2001) use the British Household Panel Survey (BHPS) to estimate the effects of self-assessed health (and especially mental health) on wages in a panel data model controlling for time-invariant individual terms. They find a significant effect of health for both men and women. Jones *et al.* (2006) provide deeper understanding on the impact of disability on individual labour market outcomes: they use the distinction between work-limiting and non-work-limiting disability to disentangle the respective roles of unobserved productivity and discrimination effects in explaining wage gaps. Their results based on LFS data suggest a significant discrimination effect for disabled men, but not for women. Gannon and Munley (2009) get quantitatively comparable results when comparing three groups of people (disabled with limitations, disabled without limitations and able-bodied) with Irish data.

Recently, some papers extended this literature and proposed statistical setups explicitly modelling the *dynamics* of disability. Using numerous waves of the BHPS, Burchardt (2000) or Jenkins and Rigg (2003) provide longitudinal studies of disability. According to the chosen definition among the available variables in the BHPS, they set out the role of the *duration* of disability spells. Burchardt (2000) evidenced that only a small part of people experiencing disability are long-term disabled, thereby detecting a mismatch between the highly persistent nature of the employment support system and the dynamics of disability, with many people encountering rather short (possibly multiple) spells of disability. Moreover, Jenkins and Rigg (2003) provide evidence of disability duration effects on labour market outcomes. They show that employment hazard rates are significantly lower at disability onset than before, but also continue to fall as disability duration becomes longer. In this line, Gannon (2005) proposed a *dynamic* panel data model using the Irish component of the European Community Household Panel Survey (ECHP) from 1995 to 2000: the transitions in and out of disability are simultaneously modelled and the dynamic setup allows to control for past disability and labour market participation effects (hence controlling for the recent household history and possible duration effects). She obtained much lower effects of disability on labour force participation than in a static setup. Gannon and Nolan (2007) using the Living in Ireland Survey from 1995 to 2001 suggest to separately consider the contribution of onset and exit from chronic illness/disability on household income and some indicators of social inclusion. They also detect

sizeable duration effects of disability.

However, much of the above literature does not consider the role of home tenure, though this factor is potentially correlated with both variables of interest: disability and labour market participation. Intuitively, one may expect that disabled people are more likely to become social renters (and less likely to become homeowners) and to receive housing benefits. In England, Local Authorities (LA) are free to set their own housing allocation policies, but must conform to some legal guidelines. Some specific households groups have to be given explicit preference for eligibility to social housing and among them "people who need to move for medical or welfare reasons" as well as those who should move to be nearer to special medical facilities. In some LA, disability (sometimes *registered* disability) is explicitly listed among the priority factors for eligibility to social housing. Moreover, claims for housing benefits (and particularly for rent rebate in the private or public rental sectors) are linked to other benefits/allowances possibly related to the health status of members of the household (the Income Support for example). Hence, we expect a larger share of social renters with large or full rent rebate among disabled than among able-bodied people.

There is also a large empirical literature on the link between home tenure and the labour market position at the individual level. Many papers (see for example Coulson and Fisher, 2002, van Leuvensteijn and Koning, 2004 or Munch, Rosholm and Svarer, 2006, with a Danish dataset) estimated the gap in transition rates to employment between homeowners and private renters. In contrast with standard aggregate results (Oswald, 1996), that evidenced a positive correlation between unemployment rates and homeownership rates in a cross-country study, these micro-studies suggested lower unemployment durations for homeowners. Using the BHPS, Battu, Ma and Phiminster (2008) consider the impact of home tenure on both job and unemployment spell durations with unobserved heterogeneity terms to account for possible endogeneity and distinguishing between various housing tenure types: homeowner, public and private renter. They notably find an important negative "public renter" effect on the unemployment-to-job transition. More recently, Gregoir and Maury (2011) use a dynamic bivariate multinomial logit modelling scheme with unobserved heterogeneity. With household level data from the BHPS from 1992 to 2008, they model all possible transitions across nine states (three for the labour market – employed, job seeker and out of the labour force – and three for home tenure – owner, private renter and public renter) at an annual frequency. They detected important two-sided causality effects: the past labour market position has an impact on current home tenure and conversely. In particular, they show that *ceteris paribus* households living in the social rental sector are less likely to get a job and more likely to leave the labour force than those living in the private sector (owners as well as renters).

We propose here to illustrate how the consequences of disability on the labour market and on the housing market may be interacting as housing tenure may have a persistent impact. The onset of disability may have direct

negative effects on the transition rate to job and may cumulate with a larger probability of switching to the social housing sector, then further lowering employment probability in the medium term. In other words, we estimate the share of the gap in labour force participation between able-bodied and disabled people that could be attributed to differences in individual home tenure histories. We work with an original multivariate dynamic panel data model based on BHPS data from 1992 to 2008, that comprises two sequentially estimated sets of transition probabilities: on the one hand individual annual transition probabilities on the labour and housing markets and on the other hand, transition probabilities regarding health. In the first set, we consider six endogenous states (three for the labour market – employed, job seeker and out-of-the-labour force – and two for home tenure – private or social sector). In the second set, we consider four endogenous states (two for disability – disabled or able-bodied – and two for the perceived health status – good or poor). All transition probabilities (for the two sets) are estimated conditionally on lagged (i.e. one year before) individual housing and labour positions and health status capturing all possible persistent as well as causality effects between the three sets of variables: The impact of disability on housing and labour market outcomes through the first set (also controlling for the dynamic link between labour and housing positions) and the impact of labour position and home tenure on health status and likelihood of disability through the second set. This large setup allows us to control for the above mentioned reverse causality effects of labour position on health. Moreover, the dynamic specification and the choice of an annual frequency permit a precise characterization of various disability spells (with possible very short – one or two years – disability spells). Among the covariates, we include different household or individual level socio-demographic factors (gender, age, family composition, education) and household specific time-constant unobserved heterogeneity terms (in the two sets). These terms enable us to control for the propensity of some persons to become (or remain) disabled: Duration dependence in disability effects and discrepancies between long-term and minor disabled is then captured. Furthermore, heterogeneity in disability spells (notably between severe non-working and short-term working disability) is also treated by separately considering two different definitions of disability (Activities Limiting Disability and Registered Disability).

Our results clearly show that some of the medium term (between 5 and 8 years) decrease in employment probability for the disabled can be attributed to a *negative social housing sector channel*. The discrimination effect on employment for disabled people cumulates with a lower probability of participating to the job market when living in the social housing sector. This latter effect is possibly due to lower incentives to look for a job since housing benefits entitlement is linked to the job position and wage of the person as well as possible additional discrimination effects for people in the social rental sector (i.e. lower employability of people living in a deprived neighborhood). The high duration of social sector tenancy spells in comparison with disability spells for minor disabled implies that the decrease in labour market participation is observed in the medium term *even when the person is no longer disabled*.

The paper is organized as follows. Section 2 presents the context: UK housing and labour markets in the 1990's and 2000's as well as changes in legislation against discrimination for disabled since 1990. Section 3 presents our dataset and some descriptive statistics. Section 4 introduces the model and section 5 the results (estimates and simulations). The last section concludes.

B The context

B.1 UK labour and housing markets

From 1991 to 2008, the national job seeker's rate has undergone sizeable changes related to the business cycle fluctuations experienced by the UK economy. The unemployment rate increased during the recession of the end of the eighties and beginning of the nineties. It had undergone a long decrease period from 1993 (10.4% unemployment rate in England according to the ONS Labour Force Survey) to 2005 (4.7%). Afterwards, the unemployment rate remained steady in 2006 and 2007 and increased again in 2008 because of the financial crisis. Notice also that the inactivity rate level is rather high in England among the working-age population[1] compared to other European countries: transitions from and to out-of-labour force status – besides usual transitions between employment and job seeker's positions within the labor force – are quite frequent. The inactivity rate also experienced variations between 1991 and 2008, especially in the recent period: according to the ONS Labour Force Survey, the inactivity rate was 23.3% by the end of 2010 compared to 22.7% two years earlier.

Changes in unemployment and inactivity rates throughout the period may also be linked to changes in the Employment Protection Legislation (EPL). Long (2009) studied the impact of changes in labour market policies on the unemployment duration from 1991 to 2006 using the British Household Panel Survey. She detected significant time heterogeneity, i.e. differentials before and after the introduction of the national minimum wage (which happened in 1998), hazard rate out of unemployment being lower after the introduction. Similar results following the UK New Deal on the labour market in 1997 were evidenced (see Stewart, 2004, for example). All these contributions suggest that the possibility of changes in the transition rates in and out of employment or inactivity over time should be controlled for. Many other structural factors, different from the New Deal and national minimum wage introduction might be a source of this heterogeneity (the list of benefits/allowances for unemployed people, as well as eligibility rules have been regularly modified since 1991). Consequently, we will include aggregate variables collected at a yearly frequency, reflecting the evolution of tightness in the English labour market to capture these potential trends in individual hazard

[1] 20.6% in 1993 and 21.2% in 2005 according to the ONS Labour Force Survey.

rates.

If we now turn to the UK housing market, we observe that following a short period of stability between 1992 and 1995, nominal home prices have been steadily rising since 1996 in almost all regions of England. The average growth rate of prices over this period is 10.90% for England as a whole according to the Nationwide Index (it lies between 12.92% for the Greater London Area and 10.28% in the North East – which is the less expensive region). This pattern is linked to a rise in the homeownership rate (the number of owner-occupied dwellings was 16.2 millions in 1997 and around 18 millions in 2008 for the entire United Kingdom; source: ONS), partly driven by innovations in the mortgage credit sector. In the same period, the number of dwellings rented from the social sector was steadily decreasing (from 5.3 millions to 4.5 millions). This decline in new social housing letting is partly due to a fall in government-subsidised new buildings and an increase in social housing sales to the sitting tenants program: the share of Local Authorities housing in the social sector is decreasing compared to new Registered Social Landlords from Housing Associations (see Whitehead, 2007) and about 400,000 social housing sales to sitting tenants took place between 2001 and 2010 (source: *Communities and Local Governments*). Finally, the number of privately rented dwellings started to increase only recently (in the early 2000's). In 2005, the total number of households in the UK private renting sector was about 2.4 millions (ONS). Notice that these temporal trends in homeownership, social and private renters rates suggest that the individual transition rates from and to each of these states could be time-varying. In particular, it is likely that the transition rate out of the social rental sector has been increasing over the period (at least in the 1990's). Hughes and Mc Cormick (2000) also evidenced that the residential mobility rates rose in the 1990's (especially in the London area or in southern regions) and Henley (1998) detected a growing residential mobility rate between 1992 and 1994 using the British Household Panel Survey. In our setup, we control for this potential time heterogeneity by including some aggregate variables related to the tightness of housing markets.

According to the English Housing Survey which combines household level data from 15 annual surveys with 15,000 to 20,000 interviews from 1993 to 2007, the majority of English households are owners (around 70% from 1993 to 2007) and among them, the main part are mortgage holders. Housing Associations represent almost 75% of the total social housing sector (as previously mentioned, the share of Local Authorities is steadily decreasing). Following Battu et al. (2008), we will not distinguish Local Authority renters from Housing Association renters in the rest of the paper. Moreover, Whitehead (2007) explains that the median rent for public renters (Housing Association as well as Local Authority) in the United Kingdom was zero after deduction of housing benefits in 2005 according to the Family Resources Survey. Furthermore, the net rent is only 4% of household income on average for public renters (25% in the private sector). All in all, more than half of public renters and between 20% and 30% of private renters receive

allowances covering their entire housing costs (excluding charges in the case of private renters) depending on the year considered. This explains why we will distinguish renters (either social or private) with 100% rent rebates from those with positive net housing costs in the rest of the paper : since the receipt of these benefits is linked to the labour market position of members of the household, it could have an incidence on transitions rate on the labour market.

B.2 Employment discrimination act

Some important policy decisions regarding disabled people of working age have been implemented since 1991. By the end of 1995, the British government passed the Disability Discrimination Act with notably different provisions on employment and housing (both on the homeownership and the rental markets) which came into force in December 1996. This Act is close to the Americans with Disabilities Act (ADA) which was introduced in the US in 1990. It aims at favouring the employment rate of disabled people by imposing some obligations to employers covered by the Act not to discriminate against disabled employees. In particular, employers have to make some adjustments in their employment arrangements to accommodate disabled employees.

The precise definition of disability according to the Disability Discrimination Act (DDA) is based on physical or mental impairment with important long term effects on the ability to undertake normal day-to-day activities. More recently, the New Deal for Disabled People (NDDP), introduced in July 2001, funded trial schemes in order to support incapacity benefits claimant at work. Meanwhile, eligibility rules for the main disability benefits had been changed to improve disabled people's incentives to work, notably through the Disabled Person's Tax Credit (DPTC) which replaced the Disability Working Allowance in 1999.

All these policies throughout our sample period [1992-2008] may generate some temporal instability in our estimates, via possible enlarged access to job for disabled people after the introduction of a new act. Hence, we proceed to structural stability tests in a robustness analysis. Many different contributions already tried to assess the impact of this act on employment and wages in the UK. These studies are based on the seminal contributions on the employment effects of the ADA for disabled persons in the US: DeLeire (2000) and Acemoglu and Angrist (2001) found negative average employment effects for men of all working ages and, in the latter paper, for women under 40. Some further contributions concluded that these results were likely to be affected by changes in the profiles of those reporting disability: Some who reported a disability before the act may no longer report it after, because of an improvement in their working conditions. Conversely, some who were not reporting disability because of possible discrimination may have done it after the introduction of the act. Differently said, one has to control for possible selection effects when assessing the employment effects of a change in legislation on disability.

Kidd et al. (2000) ran the first study on the UK labour market outcomes of disability linked to DDA. They detect a positive – though moderate – change in employment for disabled men after the DDA. Bell and Heitmueller (2009) using twelve waves of the British Household Panel Survey from 1991 to 2002 and controlling for both pre-DDA and post DDA time-varying effects of disability, detect no significant impact of the DDA on the employment rate of disabled people. This comforts us in our choice of assuming time homogeneity of the impact of disability on transition rates on the labour market.

C Data

We base our analysis on the British Household Panel Survey (BHPS) from 1991 to 2008, i.e. 18 annual waves. This nationally representative survey combines both individual and household level data. The first wave surveys approximately 5,500 households in Great Britain. For the purpose of the analysis, we only include working age individuals (i.e. aged 16-64 for men and 16-59 for women). Moreover, we restrict the sample to English households. We focus on household's head because recorded information is less precise for spouses.

The BHPS contains a large amount of detailed information on households and individual characteristics, especially on the three sets of variables we are interested in: labor market position, home tenure and health. Each year, the current labor market status (employed, unemployed or out of the labor force), past positions (previous status, year of onset of the current spell) and income (wages dynamics as well as possible benefits/allowances when unemployed or inactive). The exact definition of employment retained here is participation in paid employment. Individuals out of employment are considered job seekers when they have been looking actively for a job from one to three weeks prior to the interview. Otherwise the individual is considered out of the labor force. The BHPS also allows us to reconstitute the whole history of home tenure of households (homeownership – with a distinction between outright and mortgage – private renting and public renting – distinguishing Local Authority (LA) housing from Housing Associations HA). Information regarding residential mobility (year of last move, previous housing tenure) and net housing costs (i.e. after deduction of eventual housing benefits) is also available on a yearly basis.

There is a wide range of possible disability definitions. Notably, the literature insisted on the progressive shift from the traditional medical (or individual) model of disability toward the recent social model of disability (see Gannon and Nolan, 2007, for a more detailed presentation of both theories). The individual model of disability mainly focuses on impairments (i.e. limitations in physical and mental condition such as blindness, inability to walk, ...). According to the social model, disability refers to discriminatory barriers in society: it is the consequence of the interaction between

the disabled person and the social environment. Disability is not defined by the sole individual health condition but also by a lack of appropriate social structures, possibly restricting social activities (low employability for example).

The set of possible indicators for disability is large in the BHPS. As explained by Burchardt (2000), almost none of them is fully consistent with the two above theories (individual or social). We adopt two definitions : *(i)* ALD (Activities Limiting Disability) which corresponds to the question "*Does your health in any way limit you daily activities compared to most people of your age?*" and *(ii)* REG (Registered) which corresponds to the question "*Can I check, are you registered as a disabled person either with Social Services or with a green card?*". The first variable ALD is probably the most commonly used definition of disability in the British literature (see among other Burchardt, 2000, Bell and Heitmueller, 2009). We prefer the ALD definition to the WLD (Work Limiting Disability) also used by Bell and Heitmueller (2009) since the latter more strictly refers to the labor market position while the former may refer to both labor market and housing positions. Notice that, according to Burchardt (2000), ALD and WLD are highly correlated and generally delivers the same result. Moreover, ALD is more closely related to the 1996 Disability Act mentioned in the previous section.

We also consider the REG disability indicator in our estimates though this variable is generally omitted in the literature. The main drawback of REG is that only a fraction of disabled persons are registered[2]. Consequently, the number of registered disabled persons is far below the number of persons with ALD (4.6% and 14.4% respectively on the whole 1995 BHPS wave for example). REG more strictly refers to people with severe or long term disabilities, while ALD covers a larger set of disabled persons (and maybe able-bodied people with illness/poor health). It seems then interesting to keep both variables in our setup: REG may be a too restrictive definition and ALD a too broad one. REG is the most objective indicator based on rather steady criteria[3], but the subjectivity of ALD might also be helpful to reflect the restrained access to social activities. Finally, as will appear clearly in the following, the REG indicator is the most informative on eligibility to public housing (even if it depends on the residential location of the household, since public housing lists are administered at the Local Authority District level). All these arguments advocate for a separate analysis of the impact of both indicators, REG and ALD, on labor and housing market outcomes. The span of almost all disability definitions given here lies between these two indicators. Notice also that one important problem with using the ALD indicator is that it is not recorded in two BHPS waves (years 1999 and 2004). Due to the dynamic nature of our setup, we end up with four missing waves in the estimation procedure when using ALD.

[2]Incapacity benefits or disability living allowances are not conditioned by the registration of disabled person. Registered disabled people may only gain access to some extra social services (such as housing or public transportation) compared to non registered people.

[3]Notice nevertheless that the REG question has changed after wave thirteen. The question then became: "Can I check, do you consider yourself to be a disabled person?".

There may be sizeable differences in transition rates to employment and homeownership between able-bodied and disabled persons, but disability is not a complete proxy for health related variables. Some surveyed persons may estimate that their health status is poor and simultaneously be able-bodied. Hence, we choose to add a supplementary HEALTH variable in the two specifications. This term summarizes the perceived health status over the last 12 months (since the last interview): "*Please think back over the last 12 months about how your health has been. Compared to people of your own age, would you say that your health has on the whole been excellent, good, fair, poor or very poor?*". Compared to the disability variables, health status variable appears to be informative about labor market and home tenure spells.

Moreover, the survey also includes a wide range of information about individual and household characteristics (gender, age of head, marital status, number of children, whether spouse works, family income, dwelling size, educational attainment of head, etc.) that is useful for the model estimation. These variables are set out in the next section. After selection of our sample study, we finally obtain $37,380$ yearly observations of English household status with REG and HEALTH indicators and only $27,890$ when using ALD and HEALTH indicators (due to the four missing years 1999, 2000, 2004 and 2005). Table 1 summarizes the main descriptive statistics of socio-demographic characteristics, labour position, health status of head/household according to their home tenure and age.

When living in the private sector, heads are generally young (especially in the private rental sector), with few children and high educational attainment compared to the public sector. As expected, total family income is slightly higher for homeowners than for private renters since the former are older on average, but much above public renters' income. The share of inactive heads is much larger in the public sector (and among disabled persons) than in the private sector (and among able-bodied persons). Households living in the private sector are also less likely to have a poor health status and to be disabled than those living in the public sector. Net housing costs are higher for homeowners than for renters: the former (when having a mortgage) receive only a small amount of housing benefits on average compared to the latter. This seems to more than compensate the fact that the private rental housing is on average located in more expensive areas. Notice nevertheless that the gap is quite small compared to net housing costs paid by public renters (due to a large share of people benefiting from full rent rebate). The number of rooms per person for owners and private renters are also very close, and largely above the figures obtained for social renters. All in all, these results suggest no tremendous differences between homeowners and private renters (in spite of a huge gap in average age of head) and advocate for a simple comparison of people living in the private (with no distinction between owners and renters) and the public housing sectors.

Another interesting point is related to the persistence of disability. According to the definition of disability,

Table 1: Summary Statistics by tenure and age of head (BHPS, 1991-2008) $N = 27,890$

Variable	Homeowner by age				Private Renter by age				Social Renter by age			
	< 35	$[35-45]$	$[45-55]$	> 55	< 35	$[35-45]$	$[45-55]$	> 55	< 35	$[35-45]$	$[45-55]$	> 55
Nb Children (mean)	0.88	1.19	0.38	0.05	0.49	0.86	0.34	0.05	1.71	1.26	0.33	0.09
Head with degree (%)	21.63	21.80	16.35	10.85	26.49	18.07	14.59	15.16	2.78	5.38	4.17	0.62
Head: Good Health (%)	96.72	95.50	93.36	90.69	95.31	93.85	88.20	88.52	87.49	83.03	71.70	76.95
Head: Disabled ALD (%)	4.68	6.89	10.46	17.52	7.88	11.57	15.24	23.36	15.72	25.20	39.22	40.27
Head: Disabled REG (%)	0.91	2.14	3.94	7.73	1.63	2.81	4.93	9.42	4.84	12.23	21.05	24.66
Monthly family income (mean £)	2,186	2,489	2,515	1,772	1,199	1,556	1,437	1,326	943	1,224	1,164	925
Net monthly housing costs (mean £)	369	367	252	118	300	284	242	158	111	133	154	153
Head employed (%)	94.57	94.54	89.08	65.97	73.25	82.11	81.55	69.27	43.96	56.45	53.04	36.57
Head unemployed (%)	1.76	1.20	1.86	1.47	5.66	6.49	5.79	2.86	11.97	10.03	6.05	3.71
Head out-of-labor force (%)	3.67	4.26	9.06	32.56	21.09	11.40	12.66	27.87	44.07	33.52	40.91	59.72
Nb of rooms per person (mean)	1.98	2.14	2.85	3.04	2.26	2.22	2.59	2.94	1.33	1.78	2.52	2.60

the average disability spell duration is almost 4 years for REG and slightly above 3 years for ALD. These figures could seem low according to the conventional knowledge about disability, but are really in line with the literature. We proceed to an analysis of the average transition rates in and out of disability. These descriptive statistics will provide insights for an adequate choice of the time frequency in our econometric setup. All results are summarized in Table 2. In our sample, we observe frequent short-term disability spells (i.e. less than three consecutive years): among the whole set of disabled ALD persons at a certain date (the year of interview) approximately 30% of them will be able-bodied the following year. This figure is of course lower for registered disabled people, but still non negligible (25.11%). This result conforms to Burchardt (2000) and Jenkins and Rigg (2003) conclusions: disability is not an irreversible absorbing state. We are then able to collect a large number of multiple (both able-bodied and disability) spells at a yearly frequency: some individuals are likely to encounter at least two distinct disability spells over the observation period (see Burchardt, 2000, for some refinements on this). This enables us to control for possible selection effects in disability trajectories, since we include unobserved household-specific heterogeneity terms in our dynamic setup, controlling for possible specific propensity of some households to become disabled (or able-bodied) in the future. Overall, this important heterogeneity in disability trajectories with multiple changes in status supports the choice of a yearly frequency in our model. Table 2 provides information on transition rates in and out of the social housing sector. First, we observe that the probability of leaving the social sector is on average much lower (4.90%) than the probability of becoming able-bodied : social renter spells are much longer than disability spells (whatever the chosen definition). Transition rates out of the social sector are substantially lower for disabled persons (3% for ALD disabled and 2.33% for REG disabled). Moreover, transition rates into the social housing sector are higher for disabled persons: 1.69% for ALD disabled and 2.00% for REG disabled compared to only 0.74% for the whole sample. According to these descriptive statistics, disability and home tenure are linked. Hence, it is conceivable that a short disability spell may cause the onset of a much longer public housing spell: some public renters are former disabled

persons who recovered ability. We then need to assess to what extent the lasting consequences of a social sector spell triggered by disability may represent a large share of the total job market consequences of disability.

Table 2: Annual transitions rates for disability variables and home tenure

Position in $t-1$	Position in t	Probability
non ALD-disabled	ALD-disabled	4.69%
ALD-disabled	non ALD-disabled	30.14%
non REG-disabled	REG-disabled	1.10%
REG-disabled	non REG-disabled	25.11%
Social Renter	Private Tenant	4.90%
Private Tenant	Social Renter	0.74%
Social Renter & ALD	Private Tenant	3.00%
Private Tenant & ALD	Social Renter	1.69%
Social Renter & REG	Private Tenant	2.33%
Private Tenant & REG	Social Renter	2.00%

D The Model

Let $y_{k,i,t}$ denote the categorical response variables for household i at calendar year t, with $i = 1, ..., n$, $t = 1993, ..., 2008$ and $k = h, l, d$. $y_{h,i,t}$ is the home tenure and has two categories {private, social}. According to the preceding descriptive statistics, we do not separately treat homeowners and private renters. $y_{l,i,t}$ is the labour market position of household head and has three categories {employed, job seeker, out-of-labour force}. $y_{d,i,t}$ is the health-related variable of the household head and has four categories {able-bodied and healthy, able-bodied and unhealthy, disabled and healthy, disabled and unhealthy}. This vector is built with the two variables described in the data section: the disability (either ALD or REG) and the perceived health status over the last 12 months (the household head will be considered healthy when answering "excellent", "good" or "fair" and unhealthy otherwise, i.e. "poor" or "very poor"). $\mathbf{y}_{i,t}$ is the vector with element $y_{k,i,t}$ and $\mathbf{x}_{i,t}$ is the $(1 \times K)$ vector of exogenous covariates for household i at date t. This vector includes the following socioeconomic factors: head gender (dummy variable, one is for women), age (linearly specified), marital status (one for couples and zero for singles), number of children (linearly specified), spouse's labour market position (employed or not), log of last year's real household income, log of last year's real net[4] housing costs (when strictly positive, zero otherwise) and dummies regarding head's educational attainment (degree or above level, teaching level,

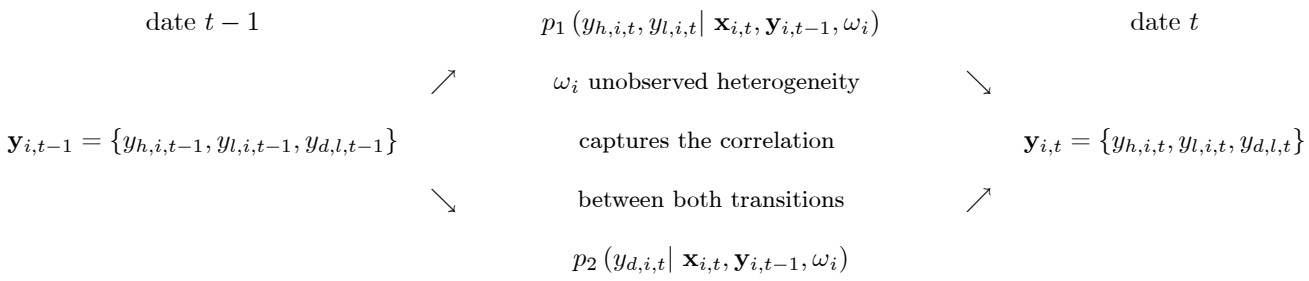
[4]Net means after deduction of eventual housing benefits.

alevel, olevel or no diploma). The number of rooms per person is included as a proxy for possible overcrowding (which is an important criteria for social housing eligibility). This vector also contains some local aggregate variables: lagged regional unemployment rate (ONS data) and the lagged growth rate of real regional home prices (taken from the Nationwide index). These two terms allow us to capture some of the time-heterogeneity in the tightness of labour and housing markets throughout the sample period.

Lagged variables $\mathbf{y}_{i,t-1}$ (i.e. last year home tenure, labour market position and health/disability status) are included among covariates to capture state dependence, i.e. the direct impact of past positions on current choices. We thus focus on the transition rate from one (health, labour or housing) position to another within a year and not on the probability of being in a position at a certain date. Modelling simultaneously all the transitions in labour and housing positions and health statuses is very demanding in terms of parameters and computation. We proceed to the estimation in breaking the set of transition into two subsets of transitions : one for housing and labour $[y_{h,i,t}, y_{l,i,t}]$ and the other for health $y_{d,i,t}$. We assume that conditionally on lagged variables $\mathbf{y}_{i,t-1}$, observed characteristics $\mathbf{x}_{i,t}$ and a time-constant unobserved heterogeneity ω_i, transitions in the two subsets are independent during the time period t. This dynamic setup implies that, in the first subset, we estimate the impact of the three sets of lagged variables $\mathbf{y}_{i,t-1}$ on $y_{h,i,t}$ and $y_{l,i,t}$ which allows us to take into account *(i)* the persistence in home tenure and labour market positions, *(ii)* the cross-dynamics of home and labour positions and notably the impact of a spell in the social rental sector on the probability of participating to the labour market and *(iii)* the impact of past individual health/disability status on current housing or labour market outcomes. In the second subset, we estimate the impact of lagged variables $\mathbf{y}_{i,t-1}$ on $y_{d,i,t}$ which captures *(i)* the duration of disability spells and *(ii)* the influence of the labour market position and type of home tenure on the likelihood to become disabled. As previously explained, the recent job history may affect the risk of work-related injury as well as distort incentives to declare itself disabled. We can therefore control for such reverse causality effects. We incidentally can illustrate the influence of recent home tenure on disability.

The panel structure of our sample (we follow the same households for a long period and may have multiple spells for labour position, home tenure and disability) permits the identification of an unobserved time-constant heterogeneity term ω_i. These terms permit to control for heterogeneity in the durations of spells in housing and labour markets (first subset) and in disability (second subset) through differences in individual transitions rates. This enables us to differentiate individuals with long-term disability (low transitions rates out of disability) from those with successive multiple short spells (high turnover rate from able-bodied to disabled and conversely). Moreover, the correlative pattern of ω_i across the two model subsets capture eventual selectivity effects: For example, some people may have a higher propensity to be jointly disabled and out-of-the labour force (or in the social rental sector). Hence, even if we

break our estimation procedure in two parts – one for housing and labour markets positions and the other for health – possible correlation between elements of ω_i allows to control for simultaneous movements between the two sets of variables.



In the first subset, let $p_1\left(y_{k,i,t} \mid \mathbf{x}_{i,t}, \mathbf{y}_{i,t-1}, \omega_i\right)$, $k = h, l$ denote the conditional distribution of the vector of endogenous variables $y_{h,i,t}$ and $y_{l,i,t}$ given $\{\mathbf{x}_{i,t}, \mathbf{y}_{i,t-1}, \omega_i\}$. Following Bartolucci and Farcomeni (2008), we adopt a *local* specification for marginal logits and for log-odds ratios. Each of the three marginal logits $\eta_{k,z_k,i,t}$ is modeled as follows

$$\eta_{k,z_k,i,t} = \log \frac{p_1\left(y_{kit} = z_k \mid \mathbf{x}_{it}, \mathbf{y}_{it-1}, \omega_i\right)}{p_1\left(y_{kit} = 0 \mid \mathbf{x}_{it}, \mathbf{y}_{it-1}, \omega_i\right)} \quad k = h, l, \quad z_l = 1, 2, \quad z_h = 1 \tag{D.1}$$

where the value taken by z_k determines the home tenure ($k = h$) or labour market position ($k = l$). In the former case, we arbitrarily select the category $z_h = 0$ to denote the "private sector" and $z_h = 1$ the social rental sector. In the latter case, $z_l = 0$ is for out-of-labour force position, $z_l = 1$ for employment and $z_l = 2$ for unemployment.

The two marginal log-odds ratios are specified as follows

$$\varphi_{z_h,z_l,i,t} = \log \left[\frac{p_1\left(y_{hit} = z_h,\ y_{lit} = z_l \mid \mathbf{x}_{it}, \mathbf{y}_{it-1}, \omega_i\right)}{p_1\left(y_{hit} = z_h - 1,\ y_{lit} = z_l \mid \mathbf{x}_{it}, \mathbf{y}_{it-1}, \omega_i\right)} \frac{p_1\left(y_{hit} = z_h - 1,\ y_{lit} = z_l - 1 \mid \mathbf{x}_{it}, \mathbf{y}_{it-1}, \omega_i\right)}{p_1\left(y_{hit} = z_h,\ y_{lit} = z_l - 1 \mid \mathbf{x}_{it}, \mathbf{y}_{it-1}, \omega_i\right)} \right] \quad z_h = 1,\ z_l = 1, 2 \tag{D.2}$$

These log odds ratio measure the gap between each pair of conditional logits. For example, a large value for $\varphi_{1,1,i,t}$ (i.e. a log odds ratio largely above zero) would mean that the ratio of probability of being a social renter ($z_h = 1$) compared to a tenant in the private sector ($z_h = 0$) for household i at calendar year t is higher when employed ($z_l = 1$) rather than out-of-labour force ($z_l = 0$). The log odds ratios explicitly deal with the *simultaneity* (at an annual frequency) of households' decisions on the housing and labour markets. Gregoir and Maury (2011) provide evidence that such simultaneous effects are present using a similar sample. We propose the following simple linear setup for marginal logits and log-odds ratios

$$\begin{cases} \eta_{k,z_k,i,t} = \alpha_{k,z} + \mathbf{x}_{i,t}\beta_{k,z} + \mathbf{y}_{i,t-1}\gamma_{k,z} + \omega_{k,z,i}, \quad k = h, l, \quad z_l = 1, 2, \quad z_h = 1 \\ \varphi_{z_h,z_l,i,t} = \overline{\alpha}_{z_h,z_l}, \quad z_h = 1,\ z_l = 1, 2 \end{cases} \tag{D.3}$$

$\alpha_{k,z}$ and $\overline{\alpha}_{z_h,z_l}$ are the intercept terms for each marginal logit (resp. log-odds) equation. The unobserved heterogeneity factors $\omega_{k,z,i}$ ($k = h, l$, $z = 1, 2$) are elements of vector ω_i. We follow Bartolucci and Farcomeni (2008) and treat the log odds ratio as constant. The presence of simultaneity is detected once $\overline{\alpha}_{z_h,z_l}$ significantly differs from zero. Overall, the simultaneous estimation of the three marginal logits $\eta_{k,z,i,t}$ and two log-odds ratios $\varphi_{z_h,z_l,i,t}$ deliver a complete characterization of the joint distribution of $y_{l,i,t}$ and $y_{h,i,t}$ *conditional on the health/disability past status.* Once the five corresponding equations have been estimated, we use the approximate iterative procedure described by Colombi and Forcina (2001) to obtain $p_1\left(y_{k,i,t} \mid \mathbf{x}_{i,t}, \mathbf{y}_{i,t-1}, \omega_i\right)$, $k = h, l$ from the vector $\left\{\eta_{i,t}, \varphi_{i,t}\right\}$. We need to complete our first-block setup with two equations for the determination of housing costs and wages, since these variables enter the dynamic logit equations and are affected by current home tenure and labour market position choices of each household. These equations are necessary for the model simulation. We rely on simple Mincerian equations for the wages and hedonic-style equations for the housing costs (see Gregoir and Maury, 2011, for further details on the methodology). We denote $g\left(w_{it} \mid \mathbf{x}_{i,t}, \mathbf{y}_{i,t-1}, \omega_{w,i}\right)$ the density of initial hourly wages and $h\left(c_{it} \mid \mathbf{x}_{,i,t}, \mathbf{y}_{i,t-1}, \omega_{c,i}\right)$ the density of initial net housing costs conditional on observed and non observed factors. $\omega_{w,i}$ and $\omega_{c,i}$ are possibly correlated with other elements of vector ω_i.

In the second subset, let $p_2\left(y_{d,i,t} \mid \mathbf{x}_{i,t}, \mathbf{y}_{i,t-1}, \omega_i\right)$ denote the conditional distribution of the vector of health/disability $y_{d,i,t}$ given $\{\mathbf{x}_{i,t}, \mathbf{y}_{i,t-1}, \omega_i\}$. We simply model a multinomial (four states) non-ordered logit model with $\eta_{d,z_d,i,t}$ defined in a similar manner as in equation (D.1). We set the following linear specification for the health-related marginal logits

$$\eta_{d,z_d,i,t} = \alpha_{d,z} + \mathbf{x}_{i,t}\beta_{d,z} + \mathbf{y}_{i,t-1}\gamma_{d,z} + \omega_{d,z_d,i}, \quad z_d = 1, 2, 3 \tag{D.4}$$

where the category $z_d = 0$ means unhealthy and disabled (reference category here), $z_d = 1$ healthy and disabled, $z_d = 2$ unhealthy and able-bodied and $z_d = 3$ healthy and able-bodied. The estimation of the three marginal logits $\eta_{d,z_d,i,t}$ deliver a complete characterization of the distribution of health/disability $y_{d,i,t}$ *conditional on the labour and housing past positions.* Overall, the joint estimation of the first and second blocks logits permits the full identification of all possible trajectories for the three sets of interest variables (i.e. labour, housing and health) and enables us to simulate individual trajectories. We denote $p\left(\mathbf{y}_{i,t} \mid \mathbf{x}_{i,t}, \mathbf{y}_{i,t-1}, \omega_i\right)$ the full conditional distribution of vector $\mathbf{y}_{i,t}$ deduced from marginal independent conditional distributions $p_1(.)$ and $p_2(.)$.

The joint distribution of the heterogeneity term of vector ω_i (that includes all unobserved heterogeneity terms in equations (D.3), (D.4) and the two continuous equations) is assumed to be normal $\omega_i \sim \mathcal{N}(0, \Omega)$. Ω is supposed to be a time homogenous with non zero off-diagonal elements matrix. Let $\mathcal{L}_{i,t}\left(\omega_i\right)$ be the likelihood expression for household i at date t conditional on all strictly exogenous covariates (omitted from the argument of likelihood to keep notations simple), on lagged endogenous variables (also omitted) and on heterogeneity terms ω_i. The expression for

log-likelihood is

$$\mathcal{L}_{i,t}(\omega_i) = \{p(\mathbf{y}_{i,t} \mid \mathbf{x}_{i,t}, \mathbf{y}_{i,t-1}, \omega_i)[g(w_{it} \mid \mathbf{x}_{w,i,t}, \mathbf{y}_{i,t-1}, \omega_{w,i})]^{e_{w,i,t}}[h(c_{it} \mid \mathbf{x}_{c,i,t}, \mathbf{y}_{i,t-1}, \omega_{c,i})]^{e_{c,i,t}}\} \tag{D.5}$$

with $e_{w,i,t} = 1$ if household i leaves unemployment or inactivity at t and zero otherwise. $e_{c,i,t} = 1$ if household i leaves the social rental sector at t and zero otherwise We deduce the overall expression of the joint non conditional log-likelihood

$$\mathcal{L} = \sum_i \log\left[\int \prod_t \mathcal{L}_{i,t}(\omega_i)\, dF(\omega_i)\right] \tag{D.6}$$

where $F(.)$ is the cumulative normal distribution function with variance-covariance matrix Ω. The complete model of transitions with a two stage simulated maximum likelihood technique: we first maximize the partial likelihood based on $p_1(y_{k,i,t} \mid \mathbf{x}_{i,t}, \mathbf{y}_{i,t-1}, \omega_i)$, $k = h, l$, $g(w_{it} \mid \mathbf{x}_{w,i,t}, \mathbf{y}_{i,t-1}, \omega_{w,i})$ and $h(c_{it} \mid \mathbf{x}_{c,i,t}, \mathbf{y}_{i,t-1}, \omega_{c,i})$ for labour and housing positions (first block) and then maximize the full likelihood expression (using the second block) using the set of estimated parameters in the first stage. We take the starting condition $\mathbf{y}_{i,0}$ as given and work conditionally on this information. We hence use a *conditional* maximum likelihood in the spirit of Wooldridge (2005): there is an initial condition issue (correlation between ω_i and $y_{i,0}$) and a different specification with the heterogeneity term distribution ω_i being explicitly and linearly dependent on the initial status $y_{i,0}$ could be tested. In practice, the model with $F(\omega_i \mid y_{i,0})$ was estimated. The dependence of the heterogeneity term distribution on the initial status was rejected using a likelihood ratio test.

E Results

This section is divided in three parts. In the first subsection, we comment the parameter estimates of the complete model (two subsets) using the ALD definition for disability. In the second subsection, we simulate the model using its dynamic nature and compute the average transition rates in home tenure, labour market position and disability for certain types of households. In the third subsection, we proceed to a robustness analysis and compare our results with those obtained with the alternative disability definition (REG). We also provide temporal stability tests and reestimate the model on some time subperiods (selected according to the changes in the disability discrimination legislation).

E.1 Model estimates

Table 3 summarizes the results of the model estimation[5]. The estimated variance-covariance matrix of the unobserved heterogeneity term ω is given in appendix. Each column in this table corresponds to a marginal conditional logit ratio (except the last line which reports the estimated value of the two log-odds ratio $\varphi_{1,1}$ and $\varphi_{1,2}$). The first group of three columns gives marginal logits of the first subset of transitions : the log of ratios of conditional probabilities of being social renter compared to that of being in the private housing sector ($\eta_{h,1}$), of being employed compared to being out of the labour force ($\eta_{l,1}$) and of being unemployed compared to being out of the labour force ($\eta_{l,2}$). The second group of columns corresponds to the second subset of transition: the log of ratios of conditional probabilities to be healthy and able-bodied ($\eta_{d,3}$), unhealthy and able-bodied ($\eta_{d,2}$) and healthy and disabled ($\eta_{d,1}$) compared to the reference – unhealthy and disabled.

The main results of the first subset of transitions are close to Gregoir and Maury (2011) and in line with most of the literature on home tenure and transition to employment in the UK. Women (when head of the household) are more likely to become social renter and to leave the labour force. Elderly heads also have a higher probability of leaving the private housing sector and of becoming economically inactive. Unless the spouse has a job, married head are less likely to participate in the labour market. Heads with a high education level are more frequently employed (no impact is detected on the relative probability of being a job seeker rather than inactive) and generally live in the private housing sector. Households living in an overcrowded dwelling (low number of rooms per person) are more likely to switch to the social rental sector (due to explicit priority for them in eligibility rules). Household's total income and net housing costs also have the expected impact: notice that households benefiting from full rent rebate (i.e. zero net housing costs) are more likely to become social renter (see Gregoir and Maury, 2011, some low-income private renter households on the social sector waiting lists benefit from large housing benefits).

We then turn to the dynamic (state dependent) relationships for home tenure and labour market position. We find evidence of significant cross-dynamics effects between both positions. On the one hand, social renters have lower transition rates into employment. Moreover, job seekers or inactive heads are more likely to become social renter at a one year horizon. These results confirm those already obtained by Battu *et al.* (2008) or Gregoir and Maury (2011). We detect a significant contribution of the two health related variables on both transitions rates on the housing and labour markets. First, disabled are more likely to leave the labour force whatever their initial position (employed or job seeker) than able-bodied persons. This confirms usual academic results on disability and employment in the UK. This

[5]The results of the estimation of wages and housing costs equations are not reported here (due to the large number of parameter estimates), but are available upon request.

effect is valid in spite of the inclusion of the household-specific unobserved heterogeneity term capturing specificities in individual propensity to leave or join the labour force. Interestingly, the presence of the disability variable does not dampen out the role played by the perceived health status on job decisions, even though these covariates are correlated as shown in the data section. Heads with poor or very poor health condition are less likely to get a job, but we do not find an important gap between the conditional probabilities to be in the unemployed and inactive states. Overall, the respective roles of ALD and HEALTH variables are easy to split up : the former having influence on the probability of participating in the labour market and the latter of finding a job. On the housing side, it appears that disabled heads have a higher probability of becoming social renters, as expected (no effect is detected for the HEALTH variable).

We detect significant simultaneity effects between housing and labour market decisions. The log of the ratio of the probability of being in the social sector over that of being in the private sector when unemployed over the same ratio when employed is strictly positive. This suggests that the conditional probability of becoming unemployed compared to employed is larger when simultaneously moving to the social sector. Such an effect could not have been captured with separate logits models.

If we turn now to the second subset of transitions, only a few exogenous covariates seem to drive the dynamics of health and disability. Elderly heads are more likely to become disabled (healthy or not) and households with children or where spouse works have a lower transition rate into disability. Heads with high educational attainment (degree or teaching level) are more likely to be simultaneously healthy and able-bodied than unhealthy and disabled, but the fact they got high educational attainment may be related to the fact that they were able-bodied when young. Once these factors are taken into account, we detect almost no significant role for the family income or net housing costs.

We find instructive cross-dynamic effects between the HEALTH and ALD variables. Previously (i.e. one year before) disabled heads are more likely to become unhealthy (when becoming able-bodied) and conversely, previously unhealthy heads are more likely to become disabled. Hence, each variable seem to had some predictive power on the other one at a one year horizon. Consequently, this may create complex medium run dynamics on the housing and labour market. For example, we already saw that the HEALTH variable has no direct (one year) impact on home tenure, but it can affect the probability of becoming a social renter at a two year horizon through its impact on the likelihood to become disabled. Such reasoning can also apply for the labour market: the full interactions between health related variables on the one hand and home tenure and labour market participation is to be quantified in the simulation subsection.

Table 3: Transition equations for home tenure, labour market and health status (disability = ALD)

Variables	$\frac{P(social)}{P(private)}$	$\frac{P(employed)}{P(inactive)}$	$\frac{P(unemployed)}{P(inactive)}$	$\frac{P(healthy,able)}{P(unh.,dis.)}$	$\frac{P(unh.,able)}{P(unh.,dis.)}$	$\frac{P(healthy,dis.)}{P(unh.,dis.)}$
Intercept	-1.2416	2.6873^{**}	0.8454	1.6759^{**}	0.3032^{**}	-0.3781
	(0.8451)	(0.4223)	(0.6273)	(0.5467)	(0.8069)	(0.5726)
Gender: woman	0.6948^{**}	-0.5048^{**}	-0.8375^{**}	0.0921	0.6198^{**}	0.1714^{**}
	(0.1311)	(0.0698)	(0.1088)	(0.0898)	(0.1299)	(0.0918)
Age	0.0095^{*}	-0.0343^{**}	-0.0349^{**}	-0.0257^{**}	-0.0319^{**}	0.0064
	(0.0056)	(0.0028)	(0.0042)	(0.0038)	(0.0054)	(0.0040)
Dummy: married	-0.5703^{**}	-0.3123^{**}	-0.4552^{**}	-0.1011	-0.0773	-0.0181
	(0.1859)	(0.0909)	(0.1342)	(0.1146)	(0.1740)	(0.1163)
Number of children	-0.1157^{*}	-0.0318	0.0370	0.0647	-0.0600	0.0014
	(0.0614)	(0.0326)	(0.0454)	(0.0420)	(0.0608)	(0.0441)
Spouse works in $(t-1)$	-0.3971^{**}	0.8403^{**}	0.2474^{**}	0.1865^{**}	0.0520	0.0302
	(0.1511)	(0.0736)	(0.1165)	(0.0937)	(0.1427)	(0.0969)
Dummy: Degree	-1.2716^{**}	0.3900^{**}	0.0121	0.4291^{**}	-0.0820	0.0107
	(0.2250)	(0.0966)	(0.1589)	(0.1320)	(0.1903)	(0.1402)
Dummy: Teaching	-1.0826^{**}	0.2151^{*}	-0.1727	0.5542^{**}	0.3635^{*}	0.1529
	(0.2765)	(0.1220)	(0.2111)	(0.1675)	(0.2164)	(0.1763)
Dummy: Alevel	-0.7139^{**}	0.1101	-0.0911	0.1182	-0.0330	-0.1265
	(0.1612)	(0.0813)	(0.1253)	(0.1027)	(0.1485)	(0.1078)
Dummy: Olevel	-0.4799^{**}	0.2407^{**}	0.0198	0.0999	-0.2573^{*}	-0.1810^{*}
	(0.1317)	(0.0715)	(0.1088)	(0.0914)	(0.1365)	(0.0960)
Rooms per person in $(t-1)$	-0.7039^{**}	-0.0188	-0.0887^{*}	0.0528	-0.0676	-0.0417
	(0.0663)	(0.0276)	(0.0469)	(0.0384)	(0.0588)	(0.0400)
$\log(\text{Income}_{t-1})$	-0.1085	0.0838^{**}	-0.0549	0.0762	0.1033	0.00983
	(0.0804)	(0.0353)	(0.0512)	(0.0496)	(0.0775)	(0.0526)
$\log(\text{Net housing costs}_{t-1})$	-0.1756^{**}	0.2485^{**}	0.0703	0.0925^{*}	0.0122	-0.0201
	(0.0842)	(0.0394)	(0.0550)	(0.0475)	(0.0706)	(0.0481)
Dummy : no housing costs_{t-1}	-1.0385^{**}	0.8094^{**}	0.1073	0.4664^{*}	-0.0169	-0.1334
	(0.4431)	(0.2127)	(0.2819)	(0.2472)	(0.3728)	(0.2461)

Table 3 (continued): Transition equations for home tenure, labour market and health status (disability = ALD)

Variables	$\frac{P(social)}{P(private)}$	$\frac{P(employed)}{P(inactive)}$	$\frac{P(unemployed)}{P(inactive)}$	$\frac{P(healthy,able)}{P(unh.,dis.)}$	$\frac{P(unh.,able)}{P(unh.,dis.)}$	$\frac{P(healthy,dis.)}{P(unh.,dis.)}$
Dummy : unemployed in $(t-1)$	0.6395^{**}	-2.4912^{**}	0.9961^{**}	-0.5482^{**}	-0.4197	0.1646
	(0.2459)	(0.1044)	(0.1289)	(0.1794)	(0.2660)	(0.1863)
Dummy : olf in $(t-1)$	0.7116^{**}	-4.3870^{**}	-1.5952^{**}	-1.0259^{**}	-0.9314^{**}	-0.3361^{**}
	(0.1566)	(0.0651)	(0.1128)	(0.0907)	(0.1432)	(0.0937)
Dummy : social renter in $(t-1)$	7.2674^{**}	-0.5182^{**}	0.0363	-0.5589^{**}	-0.2537^{*}	-0.2633^{**}
	(0.1102)	(0.0729)	(0.1042)	(0.0891)	(0.1334)	(0.0894)
Dummy : good health in $(t-1)$	$-$	0.6952^{**}	0.1673	2.6650^{**}	0.3819^{**}	2.0953^{**}
	$(-)$	(0.1001)	(0.1460)	(0.0863)	(0.1238)	(0.0832)
Dummy : disabled in $(t-1)$	0.3571^{**}	-0.7486^{**}	-0.5303^{**}	-2.9386^{**}	-1.8610^{**}	-0.0748
	(0.1491)	(0.0825)	(0.1287)	(0.0812)	(0.1339)	(0.0846)
Local unemployment rate in $(t-1)$	-0.0019	-0.1974^{**}	0.2264	-0.0321	0.2705	-0.1963
	(0.1907)	(0.0977)	(0.1559)	(0.1276)	(0.1848)	(0.1330)
Local home prices in $(t-1)$	-1.0772	0.5652	-0.1765	0.0721	1.0392	-0.2002
	(0.8232)	(0.4259)	(0.6834)	(0.5216)	(0.7502)	(0.5433)

Log odds ratios	$\frac{\frac{P(social,olf)}{P(private,olf)}}{\frac{P(social,unemp)}{P(private,unemp)}}$	$\frac{\frac{P(social,unemp)}{P(private,unemp)}}{\frac{P(social,emp)}{P(private,emp)}}$
	-0.1416	0.8923^{**}
	(0.2135)	(0.3001)

$N = 27,890$. Robust standard errors in (), ** = signif at 5% level, * = signif at 10% level

The role of lagged labour and housing market variables on health is consistent with the "reverse causality" effect exemplified in the literature: Unemployed or inactive heads are more likely to become disabled. More precisely, inactivity seems to negatively impact both ALD and HEALTH variables, while unemployment generates a gap between the conditional probabilities of being unhealthy and disabled rather than healthy and able-bodied. Moreover, we find a significant effect of home tenure, since social renters appear to have a higher probability of becoming disabled and unhealthy. Such a result does confirm the previous literature mentioned earlier of the health impact of living in a deprived area.

Finally, we find significant volatility for the terms of ω_i corresponding to each of the two sets of variables (i.e. $y_{l,i,t}$ and $y_{h,i,t}$ on the one hand and $y_{h,i,t}$ on the other one), but no significant correlative patterns between both sets of variables. No simultaneity effect in the probability of changing both its labour (or housing) position and its

health-related position seems to be present.

E.2 Simulations

The preceding table only gives information on the impact of health on home tenure and labour market position in the short run (one year horizon). However, as detailed in the last subsection some of these consequences may only show up in the medium run due to the interrelated nature of labour and housing markets. We then proceed to numerical simulations of individual paths using the dynamic nature of our framework. We select three specific head of household profiles: the first one is the average head profile drawn within the subsample of young (between 25 and 35 years) married men with a degree, the second one is an average of married men between 35 and 45 years with a A-level (but no teaching level, nor degree) and the last one of single women between 45 and 55 years with no diploma. According to table 3 – but subject to the remaining heterogeneity in income, housing costs ... – the first profile should have the lowest transition rates into inactivity or the social rental sector and the last profile the highest ones. All three profiles are selected among able-bodied heads with good health status. They are employed and are tenant in the private sector. We compute their individual trajectories on the housing and labour market in the medium run (here between 5 and 8 years) and compare them with those of three initially disabled (according to the ALD definition) but otherwise perfectly similar – same socio-demographic profiles, same income and housing costs, same unobserved heterogeneity shocks, also initially employed and living in the private sector – heads profiles. All results are summarized in tables 4 to 8.

Table 4 gives the computed medium run job position distribution – more precisely the probability of experiencing an inactivity spell anytime between $t+5$ and $t+8$ – of the three benchmark profiles and their disabled counterparts. Once again, all types of households were employed in t. It comes with no surprise that the probability of being out of the labour force is much higher for the third profile (above 40% at a eight years horizon for a single woman with no diploma) than for the first one (slightly above 2% for a young married man with a degree): this confirms the parameter estimates of the model. Moreover, when assessing the impact of disability, we detect a lower transition rate into inactivity for able-bodied than for disabled persons. The difference is rather small for the first profile (2.27% in $t+8$ for a disabled instead of a 2.03% for an able-bodied young married man with a degree), but is larger (and seemingly significant according to the standard errors computed within the dynamic simulation procedure) for the other two head profiles. For example, a single disabled woman aged 40 years approximately with no diploma in t has 68.75% chances to experience a disability spell anytime between $t+5$ and $t+8$ instead of only 53.93% for an able-bodied but otherwise similar woman. Hence, the negative labour market consequences of a disability spell onset

seem to be amplified for profiles characterized by an already higher propensity to become economically inactive.

[Insert Tables 4 & 5]

The same kind of results applies when considering housing market transitions (see Table 5). Head profiles (elderly heads with a low educational attainment) with larger average transition rates into the social rental sector are more sensitive to the occurrence of a disability event which further enlarges the likelihood to become public renters. For example, a [45-55] years single woman with no diploma, initially in the private housing sector experiences a 15.10% probability of living in the social sector at a eight year horizon compared to 11.41% when initially able-bodied. Overall, some of these results may come from the interrelationship between individual decisions on the housing and the labour market. As evidenced in table 3, people currently out of the labour force have a higher probability of becoming a social renter one year after and conversely. Hence, this fact partly explains the simultaneously higher probabilities of being economically inactive and a social renter in the medium term when becoming disabled. The onset of the disability spell contributes to raise the transition rate into inactivity (respectively social rental sector) which may further trigger the onset of a social sector (resp. inactivity) spell. This is confirmed by table 6 which summarizes the job position distribution *conditionally on having been previously in the social sector* of the same three types of head profiles. Comparing these results with those of table 4, it clearly appears that previous spells in the social sector contribute to raising the probability of leaving the labour force in the medium term in almost all cases. Importantly, it also seems that the differential in job position distribution between able-bodied and disabled is higher among the subsample of households having been previously in the social sector (this is particularly true for the first two profiles).

[Insert Table 6]

Finally, we estimate the persistence of the consequences of a disability spell. As exemplified in Table 2, there is a large heterogeneity in disability spells duration. In our setup, this heterogeneity is modelled by the unobserved heterogeneity terms introduced in the second subset multinomial logit. This captures the fact that within the simulated medium term home tenure and job position trajectories of initially disabled heads shown in tables 4 and 5, some of them may experience long term severe disability spells but others only very short disability spells. In tables 7 and 8, we focus on this latter type of disability and select the subsample of heads (for both the benchmark – able-bodied in t – and the counterfactual – disabled in t) who are able-bodied in $t+4$, i.e. at a shorter horizon than our medium term analysis. Differently said, we assess the long term job and housing market consequences of a short disability spell.

Table 7 shows that the discrepancies in job position distributions between initially able-bodied (and still so four year later) and disabled (but having recovered ability four years later) at different medium term horizons, from 5 to

8 years. Interestingly, a fraction of the differentials evidenced in tables 4 and 5 is preserved when considering solely short term disability spells. The *conditional* probability of being out of the labour force at a 8 years horizon for the third profile is 39.76% when able-bodied (the unconditional probability is 44.27%) compared to 45.26% (56.82%) when initially disabled. The gap between able-bodied and short term disabled is less sizeable (according to odds ratios) for the first two profiles. Hence, the persistence of the job market consequences of a short disability spell are particularly noticeable for households with an initially lower propensity to be economically active and to be tenant in the private housing sector. Furthermore, some of this remaining gap in the conditional job position may be due to a similar gap regarding home tenure. As illustrated by table 8, the conditional probability of being a tenant in the social sector is higher for (short term) disabled than for able-bodied (12.10% and 10.39% respectively at horizon $t+8$) for the third profile compared to the corresponding unconditional probability gap shown in table 5. This result confirms the difference between disability and social rental sector spells, the latter being on average greater than the former. A disability event may trigger the onset of a public housing sector spell that may last much more than the disability spell itself. Disabled persons suffering from restrained access to social services and employment discrimination are more likely to enter the social housing sector which may itself generate some further discrimination effects, as well as possibly lowering incentives to seek for a job. This long term effect on home tenure is then partly responsible for the limited activity rate of certain types of households profile, as detailed in table 6.

[Insert Tables 7 & 8]

E.3 Robustness analysis

We now check for the robustness of our results using the alternative variable for disability, i.e. the *registered* disability definition presented in the data section. As explained, this variable is built on the basis of a narrower definition of disability, since only a fraction of disabled persons are registered. But it is also less suspect to include ill-but-non-disabled persons as is the case for the ALD variable. We then reestimate our two-blocks benchmark model with this new REG variable. The sample size is now $37,380$. The whole set of results (estimates and simulation) is not fully reproduced here, but tables are available upon request.

The estimation delivers results qualitatively similar to those of table 3. The sign and significance of the key covariates (notably the role of lagged disability, health status, job market position and home tenure) is preserved. The impact of the disability variable is even slightly more pronounced than with the ALD definition. For example, the probability of being out of the labour force at a eight years horizon for the third profile (single woman with no

diploma) is 57.34% instead of 56.82% with the ALD variable[6]. The same is true for the probability of becoming a social renter at the same horizon: 15.90% compared to 15.10%. This comes with no surprise: registered disabled are more likely to be severe long-term disabled persons than ALD disabled. Overall, the negative persistent effects of short disability spells on medium run housing and labour markets decisions is still valid and the role played by home tenure on transition rates into activity is also preserved. Hence, this confirms the robustness of our results.

Moreover, new regressions on different subsample periods are undertaken to check for temporal homogeneity. As detailed in the employment discrimination act subsection, employment of disabled persons is likely to be affected by the Disability Discrimination Act (DDA) passed by the government in 1996. So we run two separate regressions – pre-DDA and post-DDA – using the ALD definition and detect no significant differences with parameter estimates of the benchmark model on the whole sample period [1992-2008]. Finally, other possible structural break years are tested (1997 and 1998 for the UK new Deal and the introduction of the minimum wage) and the main results are also preserved[7].

F Conclusion

This paper has analysed the joint dynamics of the labour market position, housing tenure and health/disability status of a large number of British households between 1992 and 2008. The results of this panel analysis bring out the nature and magnitude of the links between the three kinds of positions related to three capital variables: human capital, health capital and real estate asset. Transitions in each kind of position are persistently affected by the current positions in the three dimensions. We particularly focus on the impact of being a social renter on the labour market participation and how the eligibility conditions to such a housing tenure interacts with the disability status. As illustrated in the literature, there is a large heterogeneity in the distribution of disability spells. Minor disabilities may be short lived. Nevertheless, as a disability status facilitates the entering the social housing, it may lead in the medium term to a high frequency of inactivity position. The persistence of the job market consequences of a short disability spell are particularly noticeable for households with an initially lower propensity to be economically active and to be tenant in the private housing sector. The probability of being out of the labour force can be up to six percentage points higher eight year later for people having known a short period of disability and became social renters in comparison with those who do not enter the social housing sector.

[6]Notice that results are not directly comparable: profiles with ALD and REG definitions are not exactly the same due to the difference in sample sizes.

[7]Once again, results are not given here, but can be sent upon request.

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Table 4

household profile in t		Job Position Distribution (*OLF= out-of-labor force anytime between two dates*)			
Socio-Demographic	Health	Prob. OLF in $[t+5,t+8]$	Prob. OLF in $[t+6,t+8]$	Prob. OLF in $[t+7,t+8]$	Prob. OLF in $t+8$
[25-35] years, male,	able-bodied	5.23%	4.23%	3.15%	2.03%
		(0.68)	(0.58)	(0.46)	(0.25)
married with a degree	disabled	6.36%	4.93%	3.57%	2.27%
		(0.70)	(0.60)	(0.46)	(0.28)
[35-45] years, male,	able-bodied	11.72%	9.92%	8.04%	5.83%
		(1.39)	(1.20)	(0.96)	(0.74)
married with a A-level	disabled	16.76%	13.83%	11.09%	8.06%
		(1.81)	(1.54)	(1.18)	(1.02)
[45-55] years, female,	able-bodied	53.93%	51.42%	48.68%	44.27%
		(5.22)	(4.89)	(4.85)	(4.72)
single no diploma	disabled	68.75%	65.57%	62.08%	56.82%
		(6.00)	(5.77)	(5.72)	(5.30)

Table 5

household profile in t		Home tenure Distribution (*SOC= social sector anytime between two dates*)			
Socio-Demographic	Health	Prob. SOC in $[t+5,t+8]$	Prob. SOC in $[t+6,t+8]$	Prob. SOC in $[t+7,t+8]$	Prob. SOC in $t+8$
[25-35] years, male,	able-bodied	1.01%	0.90%	0.73%	0.58%
		(0.19)	(0.16)	(0.13)	(0.12)
married with a degree	disabled	1.11%	0.98%	0.80%	0.63%
		(0.22)	(0.19)	(0.14)	(0.12)
[35-45] years, male,	able-bodied	2.54%	2.30%	2.05%	1.77%
		(0.36)	(0.33)	(0.30)	(0.28)
married with a A-level	disabled	3.05%	2.77%	2.50%	2.17%
		(0.42)	(0.40)	(0.36)	(0.31)
[45-55] years, female,	able-bodied	12.29%	12.06%	11.76%	11.41%
		(1.28)	(1.26)	(1.25)	(1.16)
single no diploma	disabled	16.05%	15.81%	15.48%	15.10%
		(1.57)	(1.59)	(1.53)	(1.43)

Table 6

household profile in t		Job Position Distribution cond. having been previously in the social sector			
		$P(OLF/SOC)$	$P(OLF/SOC)$	$P(OLF/SOC)$	$P(OLF/SOC)$
Socio-Demographic	Health	in $[t+5,t+8]$	in $[t+6,t+8]$	in $[t+7,t+8]$	in $t+8$
[25-35] years, male,	able-bodied	5.45%	5.15%	3.53%	1.91%
		(0.69)	(0.67)	(0.52)	(0.32)
married with a degree	disabled	7.51%	6.59%	5.01%	3.16%
		(0.90)	(0.81)	(0.65)	(0.46)
[35-45] years, male,	able-bodied	15.10%	14.03%	12.22%	9.62%
		(1.36)	(1.30)	(1.21)	(1.10)
married with a A-level	disabled	23.37%	20.80%	17.85%	14.22%
		(1.92)	(1.70)	(1.47)	(1.29)
[45-55] years, female,	able-bodied	66.90%	65.79%	63.92%	61.03%
		(5.37)	(5.33)	(5.23)	(4.95)
single no diploma	disabled	79.60%	78.19%	75.90%	72.47%
		(6.06)	(5.96)	(5.89)	(5.78)

Table 7

household profile in t		Job Position Distribution cond. being able-bodied in $t+4$			
		$P(OLF)$	$P(OLF)$	$P(OLF)$	$P(OLF)$
Socio-Demographic	Health	in $[t+5,t+8]$	in $[t+6,t+8]$	in $[t+7,t+8]$	in $t+8$
[25-35] years, male,	able-bodied	4.95%	4.02%	3.02%	1.96%
		(0.50)	(0.38)	(0.36)	(0.23)
married with a degree	disabled	5.24%	4.14%	3.06%	1.99%
		(0.52)	(0.39)	(0.36)	(0.23)
[35-45] years, male,	able-bodied	10.71%	9.03%	7.27%	5.23%
		(0.97)	(0.82)	(0.70)	(0.50)
married with a A-level	disabled	12.20%	9.93%	7.82%	5.60%
		(1.11)	(0.89)	(0.76)	(0.52)
[45-55] years, female,	able-bodied	49.07%	46.62%	43.93%	39.76%
		(3.91)	(3.75)	(3.70)	(3.62)
single no diploma	disabled	56.87%	53.51%	49.97%	45.26%
		(4.28)	(4.16)	(4.00)	(3.71)

Table 8

household profile in t		Home Tenure cond. being able-bodied in $t+4$			
		$P(SOC)$	$P(SOC)$	$P(SOC)$	$P(SOC)$
Socio-Demographic	Health	in $[t+5,t+8]$	in $[t+6,t+8]$	in $[t+7,t+8]$	in $t+8$
[25-35] years, male,	able-bodied	0.99%	0.87%	0.71%	0.55%
		(0.13)	(0.12)	(0.09)	(0.08)
married with a degree	disabled	1.04%	0.92%	0.74%	0.59%
		(0.14)	(0.12)	(0.10)	(0.08)
[35-45] years, male,	able-bodied	2.45%	2.22%	1.98%	1.70%
		(0.34)	(0.31)	(0.26)	(0.19)
married with a A-level	disabled	2.68%	2.42%	2.15%	1.86%
		(0.39)	(0.34)	(0.30)	(0.22)
[45-55] years, female,	able-bodied	11.26%	11.02%	10.72%	10.39%
		(1.28)	(1.25)	(1.26)	(1.20)
single no diploma	disabled	13.12%	12.85%	12.47%	12.10%
		(1.61)	(1.54)	(1.49)	(1.41)