

# Housing Subsidies and Work Incentives in Great Britain\*

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Version 2.001

April 13, 2000

**JEL Class:** I38, J22, R31.

**Keywords:** welfare programmes, labour supply, housing costs.

## Abstract

In Great Britain the move away from rented accommodation to owner occupation is leaving behind a large group of households with low incomes, wages and hours of work, and high housing costs, who are increasingly in receipt of welfare transfers. The disparity along all of these dimensions between renters and owner occupiers has continued to grow since the 1970's.

The relationship between housing costs, wages and transfer programmes is complex and yet plays an important part in determining the incentive to work for individuals in low income or high housing cost households. While it is true that many individuals who are in these categories are out of the labour force (retired, sick and disabled), there are many who are not and whose incentive to seek work, or to work harder if already in work, could be modified by directly changing the rent levels they face or indirectly via changes to the structure of programmes designed to subsidise housing for the poor.

Here we estimate a static discrete choice labour supply model which allows for housing benefit programme participation. We use samples of 42491 married women and 13340 unmarried women drawn from Great Britain Family Resources Surveys 1994/5-97/8. We find that women are quite responsive to labour supply incentives, housing benefit income has similar incentive effects to earned income which suggests any "stigma" is small. Our analysis is complemented by simulating housing benefit and direct rent subsidy reforms.

\* This research was funded by the ESRC (grant R000233462), the Leverhulme Trust (grant F/368/F), the Department of Environment, Transport and the Regions, and the Keele Research Investment Scheme. Financial support from the ESRC for the *Centre for the Microeconomic Analysis of Fiscal Policy* at the Institute for Fiscal Studies, from the Danish Social Science Research Council and the Århus University Research Foundation for the *Centre for Labour Market and Social Research* at Århus University, and from the Danish Research Agency for the *Centre for Research in Social Integration and Marginalization* at Århus Business School, are gratefully acknowledged. We are also thankful to Raymond Kershaw of DETR for his comments on earlier work from which this paper derives. The data has been made available to us with the permission of the Controller of Her Majesty's Stationary Office by the ESRC Data Archive. The usual disclaimer applies.

# 1. Motivation and Introduction

In Great Britain over the past 25 years there has been large shift in housing tenure towards owner occupation: 51% of households in 1974 compared with 72% of households in 1998. This move away from rented accommodation is largely at the expense of social housing, which comprises Local Authority and Housing Association provision. Associated with this has been a growing disparity between the economic circumstances of owners and renters. The labour market participation rate for women living in owner occupied housing has remained around 65% since 1974, whereas the rate for social renters has fallen from 56% to 32%. For those who do work, there is also a growing wage rate disparity. Owner occupiers have experienced 86% real wage growth since 1974, compared with 49% for social renters.

This divergence is partly explained by a composition effect whereby entry to social housing has been available to only the poorest households, and richer renters move into owner occupied accommodation. In particular the move was away from Local Authority housing under the "right to buy" policy of the 1990's whereby tenants were offered generous discounts to buy their houses. Consequently social renters have become an increasingly impoverished group, accommodated in the lower quality social housing remaining.

Furthermore, real rents have increased rapidly, and faster than housing costs for owner occupiers. Government housing assistance policy has moved from subsidising rents directly towards income-related household subsidies. Housing Benefit (HB) is a UK means-tested transfer programme for low income households living in rented accommodation. Largely due to these rent increases, HB is now by far the most expensive income-related transfer programme, costing £9.8Bn in 1998 to support 4.5 million households. This compares with the other main UK income-related transfer programmes Income Support, Family Credit, Job Seekers Allowance and Council Tax Benefit which together cost £10.3Bn.<sup>1</sup>

There are very few studies of economic incentives in the UK housing benefit system. Wilson and Morgan (1998) describe the recent development of Central and Local Government housing finance, housing assistance and rent levels. Giles, Johnson and McCrae (1997) summarise the work in Giles, Johnson, McCrae and Taylor (1996) which provides the best and most detailed description of the HB system, its effects on the income distribution and the effective marginal tax rates faced by tenants in the social rented sector. However, no attempt is made to model behaviour and estimate work incentives.

<sup>1</sup> See Department of Social Security press releases for further details on programme-by-programme expenditures, caseloads and take-up <http://www.dhs.gov.uk/hq/press/1999/oct99>.

Ford, Kempson and England (1996) asked a small sample of individuals about their understanding of the welfare system and attitudes to working. An unwillingness to claim in-work benefits is highlighted, which suggests that it may be inappropriate to model work incentives simply as a function of entitlements as has typically been the case. Blundell, Fry and Walker (1988) model participation in the HB programme, that is, the decision to take up an entitlement. Take-up is found to be positively related to the level of entitlement and negatively to level of other income. Labour supply is assumed exogenous.

Two important recent UK studies of work incentives illustrate the alternative approaches currently in use. Blundell, Duncan and Meghir (1998) follow an instrumental variables and difference-in-differences approach to model the hours of work decision conditional on working for married women above the welfare system who face a linear tax schedule. Giles and Duncan (1996) model the discrete choice between non-work, working part-time and full-time for lone mothers potentially facing non-convex budget constraints due to the welfare system. The budget constraint is taken as given, and the focus is on modelling work incentives while ignoring programme participation.

For the US, Keane and Moffitt (1998) model labour supply and participation in a housing subsidy programme, together with participation in two other welfare programmes. The empirical methodology of this study is closest to ours. In our paper we model the relation between household demographic characteristics, housing costs, the welfare system, and female wages and work incentives. The implications of estimated labour supply incentive measures for the effects of rent levels and transfer programme design are also illustrated.

The remainder of the paper is organised as follows: The next Section presents the economic model and econometric framework, and places this methodology within the recent labour supply and programme participation literature; Section 3 describes relevant aspects of the UK Housing Benefit programme and the Family Resources Surveys Samples analysed; Section 4 presents estimation results and illustrative simulations are discussed; a final section summarises and concludes.

## **2. Economic Model and Empirical Specification**

In the absence of convincing quasi-experimental evidence,<sup>2</sup> a detailed econometric analysis of a large sample of individuals is required. There are several empirical problems which have to be addressed when taking this approach in our context. In general, hours of work, programme participation and wages may be jointly determined. For example, individuals with high ability (which is unobserved to the researcher) may both receive high wages and work long hours; or

<sup>2</sup> Good examples of studies using quasi-experimental data are Eissa and Leibman(1996) on the US 1986 income tax reform and Bell, Blundell and Van Reenen (1999) on evaluation of the UK New Deal programmes.

(unobservably) energetic individuals may work long hours and participate in transfer programmes. The goal here is to obtain an unbiased measure of financial incentives for labour supply, and ignoring these potential sources of endogeneity (spurious correlations) may potentially bias estimated parameters of interest. This paper takes the general solution to the endogeneity problem, by modelling the budget constraint and hours of work jointly.

Blundell and MaCurdy (1999) survey the recent labour supply literature and conclude that current best practice in static modelling of labour supply and programme participation takes a discrete choice approach. This is an approximation which allows incentive measurements for individuals who face non-convex budget constraints due to the welfare system, with a reasonable computational burden.

Moffitt (1983) was the first to show labour supply together with programme non-participation in a utility maximising model. Only a few papers have subsequently taken a discrete choice approach to jointly modelling labour supply and programme participation. Hoynes (1996) uses a US sample of 1010 families from the Survey of Income and Programme Participation to model household labour supply (that is three labour market states for husband and wife) together with participation in the Aid for Families with Dependent Children programme. The discrete choice framework is multinomial logit with semi-parametric mixing (discrete heterogeneity terms) following Heckman and Singer (1984). Gross wages are estimated in a reduced form first stage regression and multiplicative measurement error in hours is allowed for. Keane and Moffitt (1998) use a sample of 968 lone mothers also drawn from the US SIPP to jointly model three labour supply states, participation in three programmes, and wages. The discrete choice framework is multinomial probit without mixing terms. Duncan (1999) only considers labour supply (three states) for a UK Family Expenditure Survey sample of lone mothers, but serves to illustrate another alternative multinomial choice approach: Multinomial logit with normal mixing (continuous heterogeneity terms), following MacFadden and Train (1998).

Our approach is closest to that of Keane and Moffitt (1998) in the sense that we use a multinomial probit with free correlation structure to model choice over three labour supply states combined with participation in one programme, jointly with the wage. We allow separate wage equations for part-time and full-time work to allow for the different nature of wage determination in the UK context. Earlier versions of the model incorporated taste heterogeneity through normal mixing (random parameters on income) following Hausman and Wise (1978). But these were found to be insignificant and not improve model fit, and so were dropped in our preferred specification. Furthermore, we allow measurement error in hours following Hoynes (1996), but preferred additive rather than multiplicative errors.

To summarise features our approach: (1) Multinomial probit with unrestricted covariance (2) Taste heterogeneity is found to be unimportant in our samples and so our preferred model has no mixing. (3) Additive hours measurement (approximation) error. (4) Simultaneous part-time and full-time wages, accounting for missing wages. These features are now formalised.

We approximate the budget constraint by just six discrete points which we think of as labour market non-participation (NP), part-time work (PT) and full-time (FT), interacted with participation in the housing benefit programme at any state.<sup>3</sup> However, some individuals are ineligible to the programme in some states and face only a limited choice set. This restricted choice set is accounted for in estimation.

The choice between the six alternatives is assumed to be driven by differences in the utility attached to them. Let the utility associated with choosing state  $k$  be  $U_i(y_k, h_k; X_i)$  where  $y_k$  is the income associated with this choice and  $X_i$  is a vector of individual characteristics.

Now consider a statistical specification<sup>4</sup> which allows for random variation in behaviour due to an additive disturbance and variation in tastes<sup>5</sup>,  $U_i^*(y_k, h_k; X_i, \epsilon_{ik})$ , where  $U_{ik}^*$  is latent unobservable utility of state  $k$  for individual  $i$ . Thus, the utility gain from moving from alternative  $k$  to  $j$  is

$$(1) \quad U_i^*(y_j, h_j; X_i, \epsilon_{ij}) - U_i^*(y_k, h_k; X_i, \epsilon_{ik}) \equiv U_{ij} - U_{ik},$$

In a discrete choice model the choices  $j$  and  $k$  are assumed to be common across  $i$  so this utility difference can be expressed as

$$(2) \quad U_{ij}^* - U_{ik}^* = g(y_{ij}, y_{ik}) (\bar{\Psi} + \tilde{\Psi}_i) + X_i \beta_{jk} + (\epsilon_{ij} - \epsilon_{ik}),$$

where  $g(y_{ij}, y_{ik})$  is a row vector of differences of functions of the net incomes, and  $\bar{\Psi}$  reflects the mean tastes of the sample while  $\tilde{\Psi}_i$  is a coefficient vector which shows how  $i$  differs from the mean, and  $(\epsilon_{ij} - \epsilon_{ik})$  is an additive disturbance assumed to be iid across  $i$  but not necessarily across  $j$ <sup>6</sup>. The choice of  $g()$  is arbitrary although here we assume linearity for simplicity.

<sup>3</sup> Labour supply discretization is NP=0, PT=1-29, FT=30+ weekly hours. For the purposes of estimation, mean incomes within state are computed at 0, 20 and 40 hours respectively.

<sup>4</sup> Fischer and Nagin (1981) denote this a random coefficients, covarying disturbances model. Their notation is used above.

<sup>5</sup>  $\epsilon_{hi}$  could represent unobserved attributes of alternatives or individuals which affect choice but are uncorrelated with  $V_{hi}$ . This may also be a pure element of random choice. Note that, by itself, an additive disturbance term allows no variation in tastes. Individuals with identical observables may have different tastes, and this variance must be incorporated explicitly in the taste parameter. It can easily be shown that failure to incorporate taste variation induces a downward bias to estimates of taste parameters.

<sup>6</sup> Hausman and Wise (1978) assume  $\epsilon_{hi}$  to be iid across alternatives too.

As usual in this class of model only the utility differences between the number of alternatives minus one can be identified. This results in the need for identifying restrictions on the variance covariance of the error terms  $\epsilon_{ij}$ . Therefore we parameterize the variance covariance matrix of the terms  $(\epsilon_{ij} - \epsilon_{ik})$  such that the variance of  $(\epsilon_{i1} - \epsilon_{i2})$  equals one.

It is possible to interpret the parameters  $\beta_{jk}$  as a gain (or a loss) in utility from having the characteristics  $X_i$  when one compares the alternative  $j$  to the alternative  $k$ , where this latter choice is the reference.

From (2) the probability of observing  $i$  in state  $j$  is given by

$$(3) \quad P_{ij} = Pr(U_{ij}^* > U_{ik}^*) = Pr[g(y_{ij}, y_{ik})(\bar{\psi} + \tilde{\psi}_i) + X_i \beta_{jk} > (\epsilon_{ij} - \epsilon_{ik})] \quad \forall j \neq k.$$

We define the choices  $k$  by discretizing the actual hours distribution whereby we allocate an hours level of  $h_k$  to all those individuals whose hours fall within a range around  $h_k$ . This induces an errors in variables problem which is addressed by allowing hours to have a variance within the discrete state.

The take-up of HB is treated as an endogenous variable in our analysis: the probability of take-up is allowed to depend on the level of entitlement and other variables that also determine hours of work, and we allow for a correlation between the unobservable determinants of take-up and hours. We allow only for HB non-take-up. Relaxing this assumption to allow for non-take-up of other transfers is problematic because of the additional computational burden involved. The focus of this paper is the HB programme, which is by far the largest and suffers from the greatest take-up problem in expenditure terms, so participation in other programmes is assumed exogenously full.

The labour supply equations are identified by those observations without any transfer entitlements at any employment status: largely because they have high wages or high levels of unearned income. Identification of wages is achieved by a joint normality assumption together with exclusion restrictions: experience included only in wages, age and children included only in labour supply and take-up.

### 3. The Housing Benefit Programme and Data Description

Housing Benefit is a means-tested transfer which pays a proportion of the rent of low income or high housing cost households. The formula is as follows:

$$(4) \quad HB = \text{Max}(0, \text{rent} - \text{excess income}) - \text{non-dependent deductions}$$

$$(5) \quad \text{excess income} = \text{Max}(0, \text{earnings} - \text{disregard}) + \text{other income} - \text{needs}$$

Here *earnings* are after income tax and social security contributions, *disregard* is a small amount dependent on family status, *other income* includes income from *all* other transfer programmes, *non-dependent deductions* represent notional contributions to rent of other adults in the household, *needs* is a function of household demographics, *taper* is the transfer withdrawal rate of 0.65. The two important features of the system are the effective additional tax rate implied by the taper of 65%, and that rent changes are 100% reflected in transfer entitlement.

The raw relation between HB entitlement, receipt and labour supply is illustrated in Table 1 for the Family Resources Survey samples we use, to anticipate the dataset description below. The marginals show that married women work more than unmarried women, respectively 66% and 51%; they are less often entitled to HB, respectively 13% and 56%; and less often in receipt 8% and 43%. There are many more unmarried women who are both out of work and receiving HB, and HB non-take-up is also much more important.

Table 1 about here.

Motivation for the paper was by way of the big picture of the last 25 years shift in housing tenure, and associated growing disparity in economic outcomes between renters and owner occupiers. These trends can be briefly described in five figures based on calculations from Family Expenditure Surveys 1974-93 and Family Resources Surveys 1993/94-97/87. Each figure contains three lines, one for each of the main housing tenure categories: Social renters (housing associations and local authorities), private renters (furnished and unfurnished) and owner occupiers (owned outright and paying off a mortgage).

Figures 1-5 about here.

Figure 1 shows the headline shift in housing tenure into owner occupation. Figure 2 shows that real housing costs have increased greatly, especially for private renters. Figure 3 shows that female employment rates have remained roughly stable for owner occupiers, but social renter employment has experienced a large fall, with private renters in between the two other groups. Figure 4 presents the weekly hours distribution conditional on working. This proves to be quite a noisy series, and only a small relative fall in conditional hours can be discerned for social renters compared with the other tenures. Figure 5 shows that the lions share of real wage growth has been attained by owner occupiers.

At first glance there would appear to be four candidate datasets for a microeconomic analysis of rent and work incentives. This list can quickly be narrowed down to two alternatives, because the two other large surveys suffer from serious shortcomings for our purposes: First the General Household Survey does not contain financial information detailed enough to calculate transfer entitlements with any degree of precision. Second the British Household Panel Survey is not conducted continuously, but once each year and suffers from a "seam" problem of an infeasibly large proportion of welfare spells beginning or ending at the survey date from recall data. This leaves the Family Expenditure Survey and Family Resources Survey, which were used in illustrations above. Prior to 1978, Family Expenditure Surveys did not contain demographics required for producing reasonably accurate wage predictions. Family Resources Surveys are larger, but only available since 1994. Pooling each survey separately over time yields about the same number of observations. The advantage of FES being a longer time series of benefit reforms to exploit in order to identify incentive effects, compared with FRS which is heavily weighted toward the current system. We chose to use the FRS data on the grounds that it yields slightly more accurate benefit calculations, and contains a recent sample faced with recent welfare policies, which may be more pertinent to the current policy debate.

Our analysis uses data on earnings, hours, housing costs, welfare receipts and individual characteristics drawn from four years of the Great Britain Family Resources Surveys (FRS) from 1994/5 to 1997/8. This is a large, continuous survey of 0.1% of British households. It lends itself to the microeconomic modelling of labour market behaviour in the face of the welfare system since it has good information on welfare receipts. It is conducted by the Office for National Statistics on behalf of the Department of Social Security, and is used to compute official figures for programme participation (benefit take-up).<sup>7</sup>

In the UK, the weekly hours of work distribution has a relatively high variance for women compared to men. Moffitt (1992) summarises the empirical consensus that female labour supply is more responsive to work incentives than that of men. Consequently in this paper, we focus on measuring female work incentives as being the margin of interest. We consider separate samples of unmarried women and married (or cohabiting) women, where male partners labour supply is assumed to be exogenous. The age range is 20-59 inclusive in order to abstract from education and retirement decisions.

There are three further restrictions on the sample: First, the self-employed are excluded because of poor data quality on income and hours. Second, the disabled are excluded because they are a very heterogeneous group for which it would be difficult to fit an economic model of labour

<sup>7</sup>Department of Social Security (1997) provides a description of take-up rates computed from the Family Resources Survey.



market behaviour, especially addressing the low take-up of Disability Living Allowance. Third, multiple benefit unit households are excluded because of the difficulty of apportioning housing costs between benefit units.

## 4. Results and Discussion

The model presented in Section 2 is essentially a multinomial probit for the choice among three labour supply alternatives and participation in the Housing Benefit programme. Housing Benefit may be available at any of the labour supply states. So dependent upon rent, unearned income and wages, households may have the choice between three alternatives (pure labour supply), six (labour supply with HB everywhere), or of course four and five.

Tables 2 and 3 present parameter estimates for married and unmarried women respectively. Direct interpretation of coefficients in a multinomial model is problematic because they are estimated relative to a reference. They are presented here for completeness, and interpretation is later facilitated by defining representative individuals and simulating changes in characteristics and policy reforms.

Tables 2 and 3 about here.

However, some guidance may still be in order. Labour supply equations are in the first two columns. First comparing part-time with non-participation (PT->NP), where a positive coefficient means a relative preference for non-participation. Second comparing full-time with non-participation (FT->NP), where a positive coefficient once again means a relative preference for non-participation. HB takeup equation is in the third column, where a positive coefficient means more likely to take up. Part-time and full-time wage equations are in columns four and five. The eight income coefficients can be divided into two sets: on income in the reference state, denoted  $Y$ ; and income difference between reference and comparison states, denoted  $DY$ . These can be further divided according to source: HB denoting housing benefit entitlement; XHB denoting income from all other sources. A final division into linear and quadratic terms gives the eight.

Simulations combine the above estimated parameters with an arbitrarily defined representative individual and change each characteristic in turn in order to illustrate the modelled behaviour. Table 4 presents representative individual simulations separately for married and unmarried women.

Table 4 about here.

Consider the left part of the table for married women. The first row shows the percentage chance of the representative individual being in each labor supply state and taking up HB. Other rows show the change in this percentage due to a change in the variable defined in the row header. The first substantive row and column for example shows that the non-work-participation rate for 40 year old woman is 0.49% lower than for a 30 year old woman *all else equal*.

Married womens work is quite responsive to income at all hours of work. Unmarried women are similarly responsive out of work, but much less so in work. HB coefficients are quite similar to those for non-HB income, except for at part-time work. This suggests stigma has only a small variable cost element, and the large part is fixed costs of programme entry. Take-up generally is positive in entitlement value and negative in non-HB income. Household demographics have entirely conventional signs. According to housing tenure, priors from the raw data are confirmed, now including controls: social renters work less than private renters, who in turn work less than owner occupiers. This is now disaggregated further to show that among social tenants, those in housing associations work least; and not surprisingly, among owner occupiers, those paying off a mortgage work most.

The major worry about HB has been its potential adverse effects on work incentives. In particular, the high taper together with the large levels of entitlement, especially in high housing cost areas, imply that income and substitution effects reinforce each other and both reduce labour supply. There are two alternative approaches to resolving the issue: changing the taper, and changing housing costs through bricks and mortar subsidies. It is with these two policy simulations that we now conclude.

Policy simulations for the representative married woman of Table 4 are now presented in figures 6 and 7. Her definition is changed slightly, whereas we chose HB level previously without needing to state an associated rent, now we first choose a weekly rent of £76 and allow HB to be determined by programme rules. This is a high rent for our social renter representative, as it is the mean of private rents. Furthermore, she has enough unearned income (at zero hours, perhaps due to husbands work) so that the HB taper is already binding and rent is never fully paid by the transfer.

There are two solid lines in each of the figures, representing expected percent of the sample not working and expected number of hours worked. These are surrounded by dashed lines indicating 95% confidence bands of the simulation. Figure 6 shows the labour supply effects of varying the HB taper. Increasing the taper reduces non-work because the taper is already kicking in out of work. The associated hours increase is barely significant. The effect of choosing a lower representative rent would be to flatten off the decline in non-work at the point where HB was exhausted out of work.

Figures 6 and 7 about here.

Figure 7 shows the labor supply effects of directly subsidising rents. Confidence bands are computed under the assumption that social sector rents are currently subsidised by 30%, which is half the difference between mean social and private rents. Non-work falls as the subsidy increases, and once again there is no significant work hours effect.

## 5. Summary and Conclusion

The aim of this analysis has been to model the impact of changes of net incomes on labour supply, paying special attention to the impact of housing benefit. We find that women are quite responsive to labour supply incentives, and housing benefit income has similar incentive effects to earned income which suggests any "stigma" is small. Our analysis is complemented by simulating housing benefit and direct rent subsidy reforms. For a married women with high housing costs and unearned income (husband working), significant participation reactions to both changing the housing benefit taper (withdrawal rate) and rent subsidies are found. However hours effects are insignificant.

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Figure 1. Tenure Type

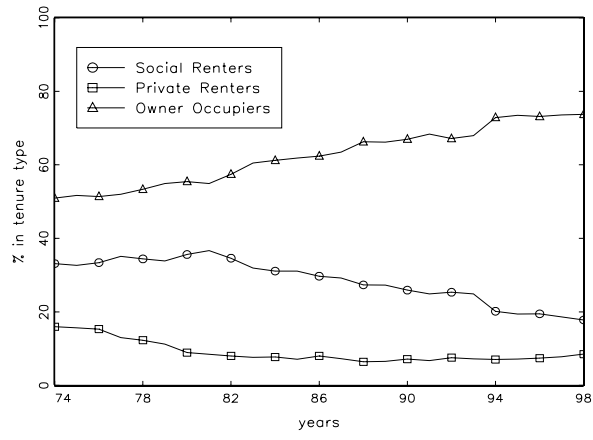


Figure 2. Real Housing Costs

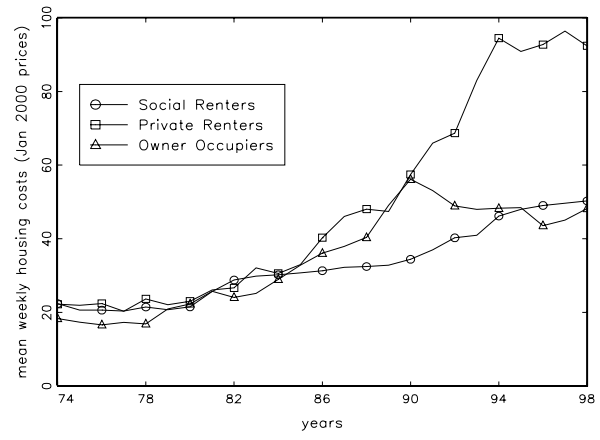


Figure 3. Female Work

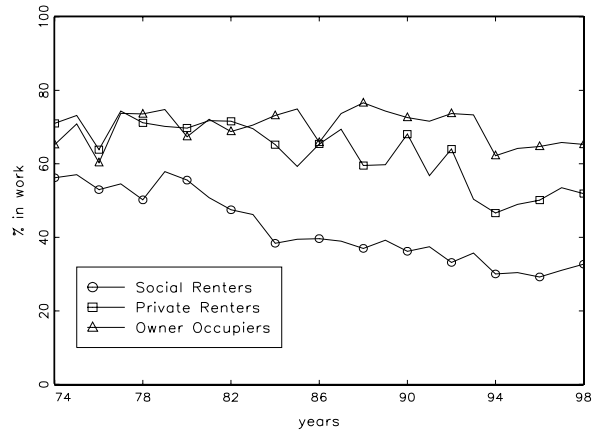


Figure 4. Female Positive Hours

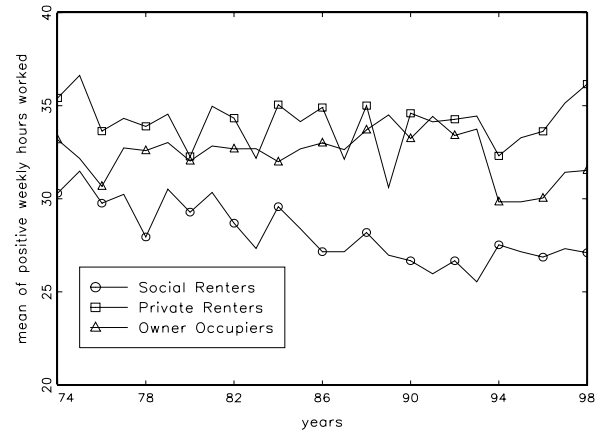


Figure 5. Female Real Wages

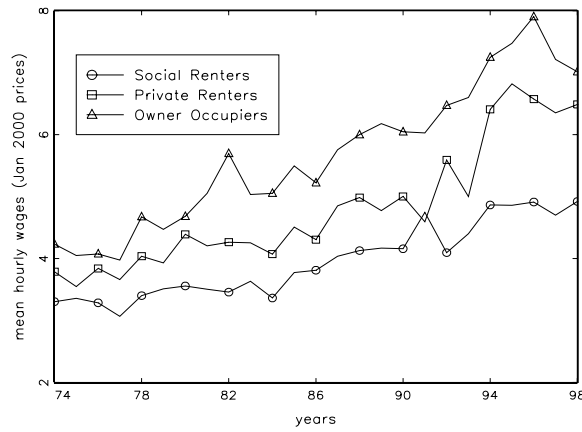


Figure 6. Housing Benefit Taper Simulation for Married Women

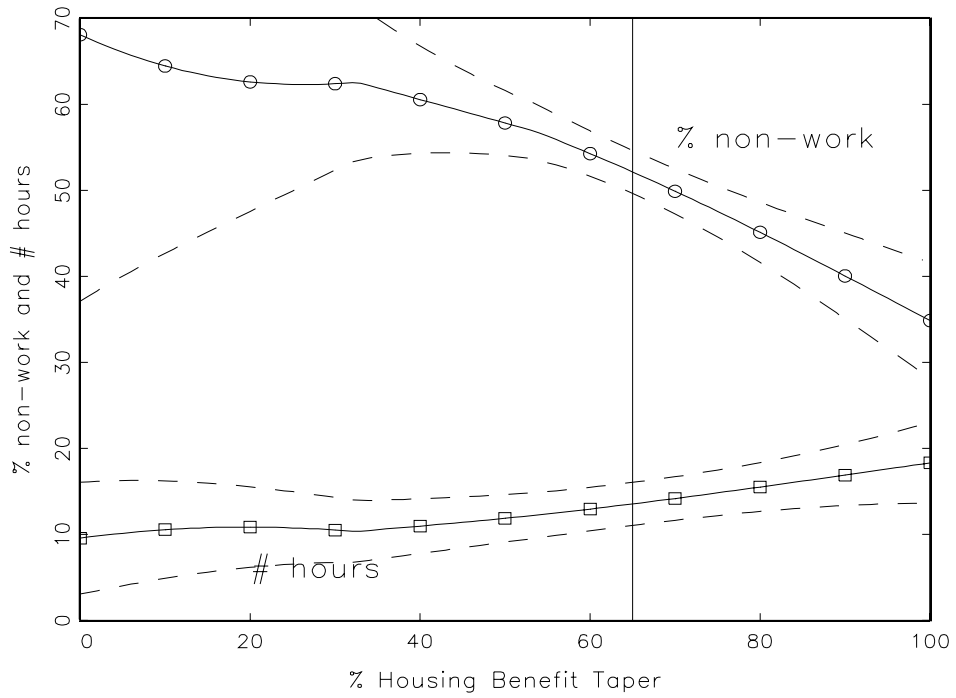


Figure 7. Rent Subsidy Simulation for Married Women

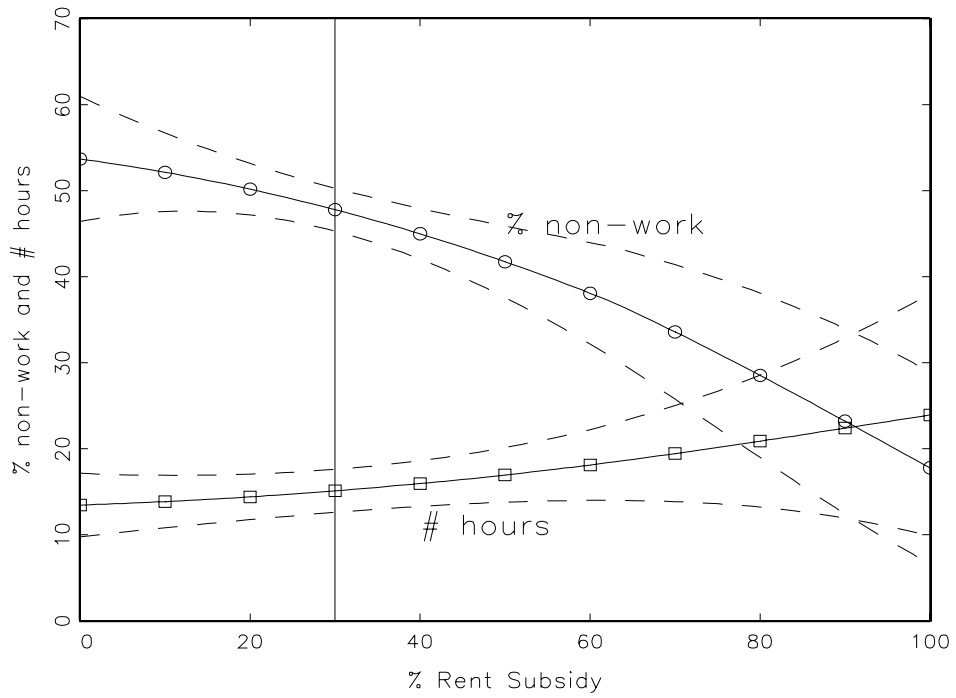


Table 1. Female Labour Supply and Housing Benefit  
% of sample in cell

Housing Benefit Status		Labour Supply Status							
Entitled	Receiving	Married Women				Unmarried Women			
		NP	PT	FT	All	NP	PT	FT	All
no	no	22.5	22.3	42.1	86.9	5.6	5.2	34.8	45.5
no	yes	0.2	0.1	0.1	0.4	0.0	0.1	0.5	0.6
yes	no	4.0	0.7	0.6	5.3	8.1	1.1	2.1	11.3
yes	yes	6.7	0.6	0.2	7.4	35.4	5.7	1.6	42.6
*	*	33.3	23.7	43.0	100.0	49.1	12.0	39.0	100.0

Notes:

1. Own calculations from FRS 1994/5 - 1997/8 estimation sample
2. Sample sizes are 42491 married women and 13340 unmarried women.
3. NP=0, PT=1-23, FT=24+ hours worked in survey week.

Table 2. Married Women Labour Supply, Housing Benefit Take-up & Wages  
Model estimates (*standard errors*)

	PT->NP	FT->NP	HB Takeup	Wage (part-time)	Wage (full-time)
Constant	1.180 0.156	2.761 0.136	0.211 0.310	-0.756 0.351	-2.354 0.212
Income					
Y(XHB)	0.009 0.001	0.012 0.001	0.101 0.007		
Y(XHB)^2	-0.014 0.003	-0.054 0.003	-0.529 0.023		
Y(HB)	0.128 0.006	0.121 0.008			
Y(HB)^2	-0.313 0.048	-0.344 0.071			
DY(XHB)	0.032 0.002	0.040 0.002			
DY(XHB)^2	-0.007 0.004	-0.016 0.003			
DY(HB)	-0.099 0.014	-0.057 0.015	0.182 0.007		
DY(HB)^2	-0.087 0.111	-0.218 0.139	-0.440 0.044		
Housing tenure					
housing association	0.022 0.018	0.170 0.019	0.409 0.022	-0.029 0.040	0.044 0.034
private rental	-0.386 0.016	-0.356 0.013	-0.291 0.021	0.088 0.033	0.132 0.023
owner outright	-0.055 0.012	0.004 0.011		0.172 0.025	0.291 0.022
mortgagee	-0.293 0.011	-0.507 0.009		0.220 0.023	0.362 0.020
Demographics					
age	-0.968 0.025	-1.095 0.024	-0.610 0.048	1.938 0.285	3.159 0.167
age^2	1.228 0.034	1.793 0.029	0.324 0.060	-0.301 0.058	-0.564 0.036
education	0.064 0.016	-0.088 0.013	0.274 0.031	0.153 0.035	0.310 0.022
education^2	-0.009 0.004	-0.006 0.003	-0.123 0.008	-0.014 0.010	-0.057 0.006
# kids 0-2	0.420 0.012	0.871 0.007	0.055 0.012		
# kids 5-10	0.110 0.008	0.520 0.006	0.145 0.010		
# kids 11-15	0.237 0.006	0.263 0.006	0.338 0.013		
# kids 16-18	0.191 0.010	0.092 0.009	0.075 0.021		
no kids	0.379 0.016	-0.260 0.012	0.064 0.024		
Regions					
North	-0.301 0.013	0.112 0.013	0.105 0.030	0.051 0.037	-0.057 0.025
York & Humbs	-0.070 0.012	0.231 0.011	-0.651 0.027	0.028 0.023	-0.024 0.016
E. Midlands	-0.049 0.011	0.063 0.010	-0.539 0.027	-0.028 0.029	-0.033 0.020
W. Midlands	-0.030 0.011	0.033 0.010	-0.626 0.026	0.037 0.023	-0.030 0.015
E. Anglia	-0.153 0.014	-0.002 0.014	-0.527 0.036	-0.023 0.034	0.015 0.024
G. London	0.209 0.012	-0.121 0.011	-0.240 0.024	0.244 0.039	0.133 0.026
S. East	-0.014 0.009	0.097 0.008	-1.124 0.023	0.034 0.034	0.129 0.023
S. West	-0.092 0.012	0.165 0.011	-0.778 0.028	-0.051 0.030	-0.034 0.021
Wales	0.086 0.014	0.483 0.013	-0.516 0.025	-0.039 0.027	-0.083 0.019
Scotland	-0.187 0.011	0.148 0.011	-0.281 0.023	0.064 0.023	0.015 0.016
Survey year					
1994	0.061 0.007	0.116 0.007	-0.116 0.017	-0.086 0.021	-0.082 0.014
1995	0.035 0.007	0.118 0.006	-0.309 0.017	-0.051 0.015	-0.043 0.010
1997	-0.043 0.007	-0.035 0.007	-0.179 0.017	-0.045 0.019	-0.015 0.013
1998	-0.071 0.011	-0.038 0.011	-0.302 0.029	-0.041 0.030	0.000 0.021
Covariance					
sigma	2.543 0.067	1.007 0.016	1.000 0.000	0.711 0.003	0.784 0.003
Wage (part-time)	0.066 0.033	-0.091 0.018	0.120 0.025		
Wage (full-time)	-0.240 0.028	0.107 0.014	0.160 0.029		
HB Takeup	0.016 0.012	-0.265 0.016			
NP->FT	0.415 0.044				

Notes:

1. Married women aged 20-60 from FRS 1994/5-97/8.
2. Maximum likelihood estimates of multinomial probit selection equations. Standard errors are heteroscedastic-consistent.
3. Reference groups are North West, 1996, local authority renters.
4. # observations=42491, log likelihood=-41475.
5. Probit variances normalised to unity. Labour supply "sigma" represents hours measurement error within state.
6. Implemented in Gauss 3.1 using 8-point numerical integration for hours measurement errors and wage prediction errors.



Table 3. Unmarried Women Labour Supply, Housing Benefit Take-up & Wages  
Model estimates (*standard errors*)

	PT->NP	FT->NP	HB Takeup	Wage (part-time)	Wage (full-time)
Constant	1.183 0.309	2.759 0.250	0.221 0.430	-2.912 0.633	-2.621 0.324
Income					
Y(XHB)	0.017 0.012	0.039 0.007	0.089 0.007		
Y(XHB)^2	-0.013 0.043	-0.054 0.021	-0.526 0.017		
Y(HB)	0.140 0.012	0.117 0.012			
Y(HB)^2	-0.302 0.123	-0.335 0.095			
DY(XHB)	0.014 0.020	-0.006 0.009			
DY(XHB)^2	-0.018 0.048	-0.023 0.019			
DY(HB)	-0.113 0.024	-0.066 0.021	0.087 0.007		
DY(HB)^2	-0.085 0.283	-0.213 0.172	-0.462 0.041		
Housing tenure					
housing association	0.026 0.024	0.176 0.019	0.410 0.022	0.001 0.040	0.116 0.032
private rental	-0.384 0.023	-0.328 0.018	-0.273 0.018	-0.032 0.037	0.271 0.026
owner outright	-0.046 0.033	-0.002 0.023		0.141 0.043	0.427 0.028
mortgagee	-0.290 0.033	-0.602 0.014		0.218 0.039	0.566 0.024
Demographics					
age	-0.955 0.055	-1.198 0.042	-0.532 0.053	1.489 0.548	3.611 0.259
age^2	1.233 0.075	1.720 0.051	0.377 0.069	-0.163 0.111	-0.635 0.054
education	0.082 0.030	-0.123 0.024	0.356 0.049	0.372 0.063	0.334 0.032
education^2	-0.023 0.007	0.020 0.006	-0.143 0.014	-0.076 0.016	-0.066 0.008
# kids 0-2	0.427 0.028	0.862 0.012	0.052 0.013		
# kids 5-10	0.098 0.022	0.531 0.013	0.132 0.011		
# kids 11-15	0.228 0.015	0.271 0.015	0.294 0.011		
# kids 16-18	0.197 0.030	0.083 0.022	0.072 0.030		
no kids	0.385 0.045	-0.262 0.026	0.086 0.021		
Regions					
North	-0.290 0.030	0.112 0.024	0.107 0.040	0.055 0.078	-0.080 0.045
York & Humbs	-0.066 0.024	0.224 0.019	-0.643 0.022	0.051 0.048	-0.007 0.027
E. Midlands	-0.048 0.026	0.062 0.022	-0.545 0.024	0.030 0.064	-0.035 0.036
W. Midlands	-0.030 0.023	0.044 0.020	-0.621 0.024	0.040 0.047	0.034 0.028
E. Anglia	-0.161 0.025	0.001 0.028	-0.528 0.031	-0.046 0.075	0.044 0.041
G. London	0.214 0.028	-0.118 0.020	-0.251 0.020	0.227 0.086	0.097 0.042
S. East	-0.018 0.020	0.097 0.018	-1.114 0.020	0.078 0.073	0.148 0.040
S. West	-0.097 0.025	0.158 0.021	-0.764 0.025	-0.001 0.066	-0.018 0.037
Wales	0.085 0.031	0.470 0.024	-0.513 0.026	-0.130 0.054	-0.043 0.035
Scotland	-0.180 0.023	0.141 0.020	-0.274 0.023	0.076 0.049	0.009 0.026
Survey year					
1994	0.060 0.018	0.099 0.013	-0.114 0.017	-0.048 0.048	-0.046 0.025
1995	0.033 0.017	0.120 0.012	-0.300 0.015	-0.006 0.035	-0.045 0.018
1997	-0.053 0.016	-0.038 0.013	-0.173 0.017	0.013 0.042	0.025 0.023
1998	-0.069 0.024	-0.033 0.018	-0.305 0.023	-0.004 0.067	0.036 0.036
Covariance					
sigma	2.378 0.100	0.767 0.031	1.000 0.000	0.682 0.005	0.705 0.006
Wage (part-time)	0.056 0.054	-0.079 0.033	0.151 0.021		
Wage (full-time)	-0.499 0.041	0.107 0.014	0.280 0.018		
HB Takeup	-0.047 0.020	-0.263 0.023			
NP->FT	0.409 0.120				

Notes:

1. Unmarried women aged 20-60 from FRS 1994/5-97/8.
2. Maximum likelihood estimates of multinomial probit selection equations. Standard errors are heteroscedastic-consistent.
3. Reference groups are North West, 1996, local authority renters.
4. # observations=13340, log likelihood=-13654.
5. Probit variances normalised to unity. Labour supply "sigma" represents hours measurement error within state.
6. Implemented in Gauss 3.1 using 8-point numerical integration for hours measurement errors and wage prediction errors.

Table 4. Labour Supply & Housing Benefit Take-up Simulations  
% Expected in each state

Reference*	Married Women				Unmarried Women			
	E(NP)	E(PT)	E(FT)	E(HBTU)	E(NP)	E(PT)	E(FT)	E(HBTU)
	49.09	29.57	21.34	39.11	57.07	16.90	26.03	85.02
age 40	0.49	5.24	-5.73	-8.33	-1.57	2.58	-1.01	-6.36
education 18	-3.86	-4.24	8.10	-10.74	-2.88	-1.05	3.93	-7.89
Y(NP)+£10	1.74	-0.86	-0.88	-1.39	1.95	-0.64	-1.31	0.44
Y(PT)+£10	-0.96	1.55	-0.59	-2.59	-0.40	0.50	-0.10	-0.31
Y(FT)+£10	-0.52	-1.08	1.60	0.72	-0.10	-0.16	0.26	-1.47
HB(NP)+£10	2.04	-1.25	-0.79	2.53	1.94	-1.00	-0.93	0.56
HB(PT)+£10	-0.21	0.47	-0.26	1.32	-0.13	0.27	-0.13	0.25
HB(FT)+£10	-1.16	-0.26	1.42	-0.98	-0.05	-0.17	0.21	0.35
1 child 0-4	14.35	-8.07	-6.28	6.71	13.56	-5.61	-7.95	1.36
1 child 11-15	-3.81	-6.60	10.41	-0.40	-5.52	-5.13	10.65	0.30
1 child 16-18	-9.24	-6.92	16.16	-10.35	-11.87	-6.03	17.90	-7.63
no children	-17.52	-15.91	33.43	-18.19	-22.02	-11.41	33.43	-13.06
housing association	4.02	0.47	-4.50	14.00	4.77	0.60	-5.37	8.29
private rental	-16.03	11.01	5.02	-16.03	-15.51	8.00	7.51	-10.61
owner outright	-1.20	2.04	-0.84	0.00	-0.87	1.23	-0.35	0.00
mortgagee	-17.39	5.24	12.15	0.00	-21.24	1.46	19.78	0.00

\*Definition of representative individual:

1. Age 30, education 16, North West, 1998, Local Authority Renter, 1 child 5-15
2. HB(NP)=£46, HB(PT)=£20, HB(FT)=£5
3. For married women Y(NP)=£180, Y(PT)=£258, Y(FT)=£363
4. For unmarried women Y(NP)=£84, Y(PT)=£146, Y(FT)=£230