A Spouse and a House are all we need? Housing wealth, labor supply and divorce over the lifecycle *

Bram De Rock[†] Mariia Kovaleva[‡] Tom Potoms[§]

October 10, 2022

Abstract

We present a limited commitment framework of household behavior in which households make decisions regarding labor supply, divorce and housing demand over their lifecycle. We identify and estimate our structural model using exogenous variation in female labor supply and divorce rates due to the *White v. White* reform in England. We show that credit market policies affect the value of marriage compared to singlehood and consequently intra-household allocations and household decisions. We conduct several policy simulations changing the ease of credit market access to illustrate. We show how accounting for divorce and intra-household allocations matters to conduct a welfare analysis of such policy changes. We also use the model to study the effects of income and employment shocks and shocks to household wealth on the secondary earner's labor supply, housing demand and the stability of marriage.

*We thank Mary Ann Bronson, Hamish Low, Maurizio Mazzocco, Daniela Piazzalunga, Carlo Pizzinelli, Hélène Turon and Alessandra Voena for useful comments. All errors are ours.

[†]ECARES, Université Libre de Bruxelles and KU Leuven. Avenue F. d. Roosevelt 50, 1050 Brussels, Belgium. E-mail: bram.de.rock@ulb.be.

[‡]ECARES, Université Libre de Bruxelles.Avenue F. d. Roosevelt 50, 1050 Brussels, Belgium. E-mail: Mariia.Kovaleva@ulb.be.

[§]University of Sussex. Jubilee Building 9SL, Falmer Brighton, BN1 9SN United Kingdom. E-mail: T.Potoms@sussex.ac.uk

Keywords: Limited commitment, divorce legislation, housing demand, labor supply, credit market policy.

JEL codes: D13, D14, D91, J12, J16, J22, K36, R21

1 Introduction

Marriage as an institution not only provides a source of companionship, but it equally allows its members to enjoy scale economies in consumption, and additional (private) risk insurance (Browning et al., 2014). The last two aspects have a broader relevance, for example, to understand how and to what extent dual-earner households can self-insure themselves against shocks, and how this compares with single households. This is particularly critical to inform policy makers on 'optimal' policy (Choi and Valladares-Esteban, 2020).

Beyond these aspects, an additional (but less studied) benefit of marriage is the fact that couples potentially have a higher ability to accumulate more wealth, typically concentrated in large, illiquid assets such as housing. Clearly, this feature interacts closely with the risk-insurance and consumption sharing aspects. Indeed more attention has been devoted in recent years to understand the way household's consumption and labor supply choices are affected by their portfolio composition, and more specifically, housing wealth.

The first channel through which housing impacts lifecycle choices (and the ability of households to provide self-insurance) is direct: households with relatively larger amounts of liquid wealth (savings) can use the latter as a buffer against earnings losses, whereas those households with the vast majority of their assets being illiquid (in particular, housing) can't use savings as a cushion against shocks. Clearly, this has broad consequences, including for fiscal stabilization policy (Kaplan et al., 2014; Kaplan and Violante, 2014; Kaplan et al., 2018).

The other channel through which housing demand impacts on lifecycle decisions and households' ability to provide risk insurance for their members is through labor supply. Indeed, homeownership necessitates sufficient income flows to pay off debt. Furthermore, the (often) more variable labor supply of the secondary earner serves as an important source of insurance against income and employment risks to the primary earner. This has usually been referred to as the *added worker effect* and has been shown to be crucial for the size of intra-household insurance (Blundell et al., 2016), as well as to conduct welfare analysis (Wu and Krueger, 2021). Given the link between housing and the secondary earner's labor supply, a joint study of their dynamics over the lifecycle is quintessential to quantify (possibly heterogeneous) added worker effects.

The lifecycle dynamics of household labor supply and savings are clearly affected by the presence of divorce risk (Blundell et al., 2016). Equivalently, the dynamics of homeownership rates at the aggregate level have been shown to be significantly affected by marital transitions (Chang, 2020). However, these interactions have been studied using exogenous marital transitions, which provides good insights at the aggregate level, but might be less appropriate to study the interesting joint dynamics between housing demand, labor supply and stability of marriage. the way the dynamics of housing demand, labor supply and divorce interact with each other endogenously (i.e., divorce as a choice outcome of the household) has not been studied and clearly is important to understand housing demand and labor supply. This further reinforces the need to model housing and labor supply choices jointly with the decision to divorce.

We believe we have identified a gap in the literature, which has either focused on modelling housing and labor supply within the context of stable marriages and/or exogenous divorce risks on the one hand or studied labor supply and (liquid) wealth (in particular savings) decisions with endogenous divorce (Mazzocco et al., 2014) on the other. This paper aims to bridge this gap. In particular, we present a limited commitment framework (in the spirit of Mazzocco (2007)).

We allow for endogenous divorce and study how (opposite-sex) households make choices about consumption, labor supply and housing demand over the lifecycle. An important feature of our model is that a household which chooses to buy a house is faced by leverage-based constraints. Specifically, loan-to-income (LTI) and loan-to-value (LTV) constraints. Both of these put a limit to the amount of debt the household can accumulate. The restriction pertaining to the LTI ratio postulates that debt is constrained by a multiple of the household's income, whereas the LTV-constraint imposes a limit in terms of a fraction of debt with regards to the value of the house.

In our model, though we assume that the male spouse always works full time, the wife's labor supply is assumed to be variable[1], which affects the household's ability to build up debt over the lifecycle, through the LTI constraint. Shocks in the primary earner's income make it more likely that the LTI constraint becomes binding, which can be compensated by an increase in the wife's labor supply. In addition to this direct mechanism, a reduction in the husband's (potential) earnings is allowed to affect the intra-household resource allocations, due to the absence of full commitment devices. In particular, the model would suggest that a sufficiently large negative shock in the primary earner's income will induce a renegotiation of resources in favor of the secondary earner, which can thereby dampen the response in her labor supply (due to the disutility of work.) Furthermore, each spouse can choose to divorce in case such renegotiation fails. Both of these intra-household dynamics are an important and novel aspect we add to the literature of intra-household insurance and lifecycle models. In addition, the paper also contributes to the literature on limited commitment collective household models, by incorporating home ownership and illiquid asset accumulation as choices.

To identify the model, we exploit the *White v. White* reform, which generated

[1]This is in line with the vast majority of the literature, in which the wife's market hours is considered to be the variable component of household labor supply.

a change in the principles guiding the division of assets and wealth after divorce within England. Furthermore, given that this law case did not apply to Scotland, we have a quasi-natural experimental environment in which we can study how exogenous changes in the outside options to marriage affect decisions within the household.

To be more specific, we use the difference-in-difference estimates of responses in female labor supply and divorce rates, together with other empirical moments to identify and estimate our structural limited commitment collective household model. One of the insights from our framework is that credit market policies, in particular regarding the ease at which households can borrow or accumulate debt, directly impacts the relative value of marriage over singlehood. This connection then suggests broader effects of credit market policies for households' outcomes, in particular they can amplify labor or mitigate labor supply effects and impact marital stability.

To investigate this issue further, in the last part of the paper, we have conducted several policy experiments. In particular, we study changes in the access to credit by either a tightening or loosening of the LTI or LTV constraints. We uncover several interesting findings. First, changes in credit market access have direct effects on the labor supply decisions of the secondary earner, both through the standard channel (i.e., the endogeneity of the borrowing constraint to the secondary earner's labor income) and the additional mechanism of how the intra-household sharing of resources is affected by changes in the borrowing constraint.

To be more precise, we find that a tightening in the LTI and LTV limits affect the spouses' relative value of marriage in an asymmetric manner. In particular, such tightening of the borrowing constraint makes the pooling of income in marriage less efficient in terms of accessing credit to accumulate housing wealth. This mostly affects the secondary earner, who is treated asymmetrically to the primary earner in the borrowing constraint. As a consequence, the secondary earner's outside value from marriage becomes relatively more attractive, which triggers more marital instability (divorce), or, through our assumption of limited commitment, a renegotiation of the intra-household distribution of resources.

The importance of the extent to which a household can accumulate housing wealth and marital stability is further confirmed by the fact that most of the effects on divorce are concentrated among those households on the margin of the housing decision, i.e., those households who became renters in the counterfactual scenario of a tightening of the household's borrowing constraint.

We also conduct a welfare analysis of a loosening or tightening of credit market access. Again, we uncover some interesting findings. First, we find lower welfare losses from an LTV tightening, compared to a tightening of the income-related debt limit. This is related to the fact that the former generates a less persistent drop in the homeownership rate, and mostly affects the intensive margin of housing demand, i.e., the investments in housing size. Second, we find that ignoring the channels of divorce and limited commitment can lead to severe biases in the estimated welfare effects of a policy change. This again illustrates the rationale for our approach to include a limited commitment model of household behavior.

We contribute to several strands of literature. First, we add to the vast literature that studies lifecycle labor supply and consumption, and in particular how households can insure themselves against shocks. Much early attention has been devoted to the variability of consumption to (un-)anticipated (income) shocks, e.g., Attanasio et al. (2008), Heathcote et al. (2014). Another (large) literature, starting with Lundberg (1985) has focused on the *added worker effect.*

In a very important contribution, Blundell et al. (2016) studies self-insurance of households, combining channels such as (liquid) savings together with a variable secondary earner's labor supply. Furthermore, they allow for (exogenous) divorce risks. Their framework is very rich, however, an important restriction is that households are *unitary*, which implies that dual-earner households behave as if they are a single decision maker. More formally, they impose full commitment on household decision making, which implies that large unexpected shocks cannot affect the intra-household division of resources beyond (direct) effects on total household's resources.

While Attanasio et al. (2011) and Attanasio et al. (2012) have thoroughly analyzed housing demand and the interaction between housing wealth and consumption over the lifecycle, they did not include household labor supply. In that respect, there have been only a few papers trying to study both housing demand and the household's labor supply over the lifecycle. Noteworthy exceptions are Bottazzi et al. (2007), Pizzinelli (2018) and Bartscher (2020). However, an important restriction of these papers is that they all model households as single decision makers. Another noteworthy contribution is Lafortune and Low (2020), who have argued for the importance of joint held assets (in particular housing) as commitment devices for intra-household specialization, in particular for secondary earners to invest in children and other public goods.

Our paper contributes to this part of the literature by only assuming limited commitment among spouses, which means that the intra-household resource allocations is allowed to evolve in response to large, unexpected shocks in the economic environment. As a consequence of this, spouses cannot commit to ex ante Pareto efficient plans. This feature directly affects the incentives to invest in joint assets, similar to Lafortune and Low (2020). However, in contrast to the latter, we also highlight the heterogeneity in female labor supply by leverage ratios, which might counteract some of the benefits to intra-household specialization.

The theoretical foundations for our model rely on the seminal contributions on the *collective household* model in Chiappori (1988, 1992) and its dynamic extension in Mazzocco (2007). Our model incorporates the basic elements of the risk-sharing, limited commitment environments as found in Ligon et al. (2000), Ligon et al. (2002), Mazzocco et al. (2014), Voena (2015) and Low et al. (2018). We contribute on a formal level to this literature by incorporating housing demand into a dynamic collective household model.

The outline for the paper is as follows: Section 2 discusses the exogenous variation in the *White v. White* reform which we exploit for identification and estimation of our structural model. Section 3 presents the structural model. Section 4 discusses identification and estimation of the model. Section 5 presents the estimation results and descriptive statistics from the model simulations. Section 6 presents the policy simulations. Finally, Section 8 concludes the paper. All tables and figures are contained in the Appendix.

2 The *White v. White* reform

The main focus of our paper is to study the interaction between home ownership, labor supply and intra-household bargaining. In order to allow our structural dynamic model to be sufficiently credible (especially with respect to policy experiments later on in the paper), it is quintessential to be able to match important empirical patterns found in the data. Furthermore, it is extremely useful to exploit any exogenous variation which would allow us to identify fundamental aspects of our model. To that end, we will apply a similar strategy as has been applied by Voena (2015) and study changes in divorce legislation to identify specific parts of our dynamic model. In particular, we will use an interesting case which drastically altered the division rule for property and assets upon divorce, namely the so-called *White v. White* case. Of specific interest is how this change in divorce law has affected the labor supply of women (who are in general the main beneficiary of the *White v. White* case) and the overall divorce rate. These responses will then be used later in the paper to identify specific parts of our dynamic model. We will first briefly explore the background on divorce legislation in England and Scotland and then provide difference-in-difference estimates of how *White v. White* affected households' outcomes.

2.1 Institutional background

Given the importance of the *White v. White* case in our analysis, in particular with regards to identifying parts of our structural dynamic model (cfr.infra), it is important to give some background on this case and generally divorce law in the UK. Though divorce law is generally quite extensive in scope and history (including regulations regarding grounds for divorce, child custody etc.) For the purposes of the present paper, we are mostly interested in the aspect of property and asset division upon divorce. Very broadly speaking, one can make a distinction between the following (stylized) three regimes:

- *Titular-based property division*: in this case, property and/or assets are divided based on the (primary) nameholder of said assets.
- *Community- based division*: all property and assets acquired by spouses are treated as property of the couple (community) and are divided equally among the former spouses.
- *Equitable division*: discretionary judicial division of joint (matrimonial) assets.

England and Wales have, with some generalization, an equitable division system, in the sense that courts have a large amount of discretion in deciding splits of property and wealth among spouses upon divorce. This is an important difference with other countries, e.g. France or Italy, where people can choose between a particular default property regime and an alternative one. Furthermore, as noted by Smith (2003) and Piazzalunga (2017), pre-marital contracts regarding division of property are also quite uncommon in the United Kingdom, given that such contracts are not legally binding. Both of these aspects in divorce law are quite useful for our own analysis in this paper, since we do not have to be specifically concerned about selection effects of individuals into particular property division regimes.[2] In contrast, ex-post agreements between spouses are encouraged. When spouses agree on such a division, the proceedings for divorce are simplified in the sense that the court just needs to issue a cheaper 'consent order'. In contrast, when the spouses can't agree on such a settlement, the court needs to issue a financial order, which takes more time and is more expensive.[3]

From a practical perspective, the division rule as applied before the *White v. White* case was such that, when wealth (matrimonial assets) exceeded the financial needs of the household members, the remaining proceedings were distributed on a 'needs-based' system, that is, taking into account the specific financial needs of the former spouses and their standard of living they were used to.[4]
As noted in Piazzalunga (2017), who cites the *Ferguson v. Ferguson* case from 1994, the court in that case described such an equitable regime as "more fair" than a titular-based system. However, as noted by Smith (2003), in most cases the courts didn't grant much larger shares to the wife, except for special cases (e.g. in the case where both partners were also business partners) and the wife didn't receive a share larger than 50 % and in most cases much smaller shares of previously joint assets (Smith, 2003; Piazzalunga, 2017). A particular example

[2]Though an analysis of sorting into division regimes has been conducted by Bayot and Voena (2015) for the case of Italy.

[3]Though the option of agreeing ex post on a division rule is important, from an economical perspective the relevant factor is still the (credible) outside option of what each spouse could obtain through a financial settlement enforced by the courts. If the latter employ a more egalitarian division of property, then this would benefit the economically weaker spouse at the point of bargaining.

[4]In practice, courts made (and in some case still make) use of the so-called 'Duxbury Tables' to calculate the 'reasonable needs' of each spouse. In particular, it is a lump sum amount that is calculated based on the assumption that the economically weaker spouse spends a share of capital and interest received in such a way that when (s)he dies, there is no capital left. As noted by Stowe (2009), in most cases such discretionary court decisions are far from comparable with the 'usual lifestyle' and didn't allow much resources for bequest motives.

of the latter is the so-called *Dart v. Dart* case in 1996. Mr. and Mrs. Dart moved to England from the US (Kentucky), but were living in England when the wife filed for divorce. Mrs. Dart tried to get the case settled in the US, but eventually the case was decided in English courts. The stakes were quite large, given that Mr. Dart had a large fortune estimated to 400 million GBP. Mrs. Dart sought to get a settlement at around 100 million GBP. However, she lost both at the High Court and the Court of Appeal and eventually only got awarded 8.5 million GBP and had to pay the legal costs of her husband.

The *White v. White* case is considered as a decisive change in this pattern of property and asset division upon divorce. Mr. and Mrs. White were business partners of a farming business in Somerset. At the time when the court case regarding their divorce came up, their combined net wealth was estimated at approximately 4.5 million GBP. Initially, Mrs. White was awarded a sum of 980,000 GBP, to which she appealed. The Court of Appeal then granted her 1.5 million GBP, using a 'yardstick of equality'. This decision was then confirmed by a ruling from the House of Lords in October 2000, where Lord Justice Nicholls in particular specified that, when a couple starts with a small amount of assets, which then grow considerably over the course of the marriage, both spouses, including the wife, should expect to receive half of that accumulated wealth, even if she has "never or rarely worked outside the home" (Stowe, 2009). Another argument was made by Lord Justice Thorpe, who argued that typically the wife " sacrifices her potential to generate assets by taking on the domestic commitment to her husband and her children." All this implied that, ever since this case, "the 50/50 split is, more often than not, a given." (Stowe, 2009)

Clearly, it should be stressed that most of the cases in which this decision was applicable were mostly 'big money' cases, where the amount of the matrimonial assets are sufficiently large to cover the financial needs of the (former) spouses. However, Smith (2003) argues that the case had a much broader impact on post-divorce division of assets, beyond the 'big money' cases. Furthermore, as Piazzalunga (2017) notes, the *White v. White* case received broad media attention, thereby informing all married individuals of the possibility that, after divorce, there will be a revised division of joint assets which is generally more beneficial to the economically weaker spouse. From a theoretical point of view, this is an important point as this adjusts the outside options for a broad range of married individuals, thereby potentially affecting household's choices, even if they remain married. Such effects by divorce legislation has been previously studied in Chiappori et al. (2002), where they show how changes in divorce legislation affect household's labor supply through changes in the intra-household bargaining power. The latter is a direct consequence of the change in the spouses' outside options.

Another important aspect of the policy change is that it only applied to both England and Wales, but not to Scotland, which has its own legal framework regarding divorce. This is very useful from an empirical point of view, given that the *White v. White* case can be considered a quasi-natural experiment, where households living in England and Wales are in the treatment group, whereas people living in Scotland can be considered to be in a control group. Hence, one could apply a standard difference-in-difference analysis for several household outcomes (e.g. the wife's labor supply) where the treatment is the change in the divorce law due to the *White v. White* case. We now turn to such an empirical analysis of the *White v. White* case, given its importance for our further structural estimation in the remainder of the paper.

2.2 Data and empirical evidence

We now turn to the estimation of how specific household outcomes respond to the divorce law change.[5] Throughout the paper, we will mostly use the British Household Panel Survey (BHPS), which is a widely used panel dataset on UK households running between 1991-2008 and contains a rich amount of information on demographic characteristics, labor supply decisions etc. The first wave of the BHPS contained approximately 5,500 households, which sums to about 10,000 respondents. In addition to this basic sample, which was representative for the national population of the UK, there were boost samples between 1997-2001 consisting of lower-income individuals and from 1999 there was a boost of respondents from both Scotland and Wales. To study the effects of the *White v. White* case on households' labor supply (and other outcomes), we apply some sample restrictions. To be more precise, we consider married women between 25-60 years old living in England or Scotland.[6] The sample range is restricted to 1992-2005, given that some controls at the country-level[7] are not available in 1991 and in 2006 there was the introduction of the Scottish Family Law, which could act as a confounder to the analysis, hence the restriction of the range to 2005. A more thorough description of the data, including some summary statistics can be found in A.

To study the effect of the *White v. White* case on household decisions, we employ a very traditional difference-in-difference regression, with the treatment group defined as (married) women living in England and the control group (mar-

[5]We also like to explicitly refer to Piazzalunga (2017), who has conducted a similar and thorough empirical analysis of the reform on the same dataset.

[6]Similar to Piazzalunga (2017), we do not consider Wales in the empirical analysis. However, in order to have a closer fit between the reduced form evidence we present here and our dynamic structural model (see Section 3), we opted for a different age range. In particular, we focus on (married) women aged between 25-60 years old, in contrast to the age range Piazzalunga uses, which is 18-55 years old. The results are nonetheless very similar.

[7]We also follow the convention and refer to England, Wales and Scotland as 'countries', whereas the metropolitan and government regions will simply be referred to as 'regions'.

ried) women living in Scotland. Clearly, the validity of applying difference-in-differences needs to be verified (e.g. common-trends assumption, the absence of contemporaneous policy changes etc.) We preserve the full discussion on validity of the following empirical analyses to the Appendix, see D. For the purposes of the research in this paper, we are mostly interested in the effects of the *White v. White* case on the labor supply of (married) women and the effect on divorce rates. To start, we estimate regressions of the following form:

$$Y_{i,c,r,t} = \phi_1 Post \times \ Treated_{c,t} + \mathbf{X'}_{i,c,r,t}\gamma + \sum_t f_t + \sum_r f_r + \epsilon_{1,i,c,r,t}, \qquad (1)$$

where Y is an outcome variable of interest, for a respondent i, living in country c ('country' being either England or Scotland), region[8] r in year t. The outcome variables we are particularly interested in are *Hours*, the number of working hours for married women[9] and *Employment* which is an indicator whether a married woman in our sample is employed or not.[10]

$Treated_{c,t}$ is an indicator for being in the treatment group. In particular, $Treated_{i,c,t} = 1$ if the respondent is living in $c =$ England in year t. The dummy variable *Post* equals one if the year $\geq$ 2000. We always include a full set of region and time dummies, f_r and f_t, as well as demographic controls at the household and individual level, and which are collected in $\mathbf{X'}_{i,c,r,t}$.[11] Furthermore, we always

[8]For regions, we use the administrative region or metropolitan area.

[9]There are several measures for working hours available in the BHPS. The three most common definitions of hours worked involve (i) contractual hours worked, (ii) contractual hours + hours of paid overtime and (iii) contractual hours + total overtime hours. We estimated (1) using all three measures and results are very similar, a finding which was also found in Kapan (2008) and Piazzalunga (2017).

[10]We experimented with several definitions of being employed in the BHPS, e.g., based on whether or not the respondent has done paid work in the week leading up to the interview, an alternative measure based on self-reported employment status and finally one based on reported hours worked. All these measures gave us very similar results.

[11]Specifically, we include the age and age squared of the respondent, the age and age squared of the husband, the education level of the wife, the education level of the spouse; both defined as their highest qualification received, number of young children ($\leq$ 15 age old) and the

control for the country-level female unemployment rate. Cross-sectional weights are used in all regressions. Finally, we cluster standard errors at the individual level. The results are given in Table 2.

There is evidence for an average decrease in working hours by about 2.4 hours per week.[12] This is completely in line with earlier findings by the earlier empirical studies on the *White v. White* case, Kapan (2008) and Piazzalunga (2017). Furthermore, also in line with those earlier findings, we do not find any significant change in terms of the extensive margin of female labor supply. The result can be sharpened by exploiting the panel dimension of the BHPS. To that end, we restrict the sample to those individuals which we observe continuously over a period from before the reform and after the reform. This allows us to include individual fixed effects in the specification (1).

Furthermore, as a placebo test, we also ran similar regressions as (1) for cohabiting and single women[13], and found no effects of the *White v. White* case, which can be seen as a confirmation that our difference-in-difference results are capturing the short run effects of the *White v. White* case. This comment will be important later for the findings from our dynamic structural model as well. We also didn't find any effect of the change on the labor supply (neither on the intensive, or extensive margin) of married men. The details of these findings can again be found in the Appendix, see D and E.

Our next exercise is to study the effect of *White v. White* on divorce rates. However, given the rare occurrence of divorce in the BHPS, we will follow Piazzalunga (2017) and study the effect on the (crude) divorce rate, which is defined as the number of divorces per 1,000 people. To compute these, we used the Office for National Statistics (ONS) Vital Statistics annual reference table on marriages,

household's non-labor income.

[12]The alternative definitions for hours worked per week gave similar results, i.e., a decrease between 2-3 hours per week.

[13]'Single' is defined as never married, to not have an effect through divorcees who chose to divorce due to the divorce law change.

partnerships and divorce and the Mid-point population statistics. Given that England and Wales are reported jointly in terms of divorces, we consider the difference in divorce rates between England and Wales on the one hand and Scotland on the other. Figure 2 shows how the divorce rates evolved over the years.

The divorce rate is always larger in England (and Wales), compared to Scotland. Before the change there seems to be a declining trend in the divorce rates for both England and Wales on the one hand and Scotland, however from 2000 onwards , whereas there is an uptick in the divorce rate in England/Wales, the declining trend in Scotland continued. To assess quantitatively the effect of the *White v. White* case on (crude) divorce rates, we estimate the following[14]:

$$Divorce_{c,t} = \tilde{\phi} Post \times Treated_{c,t} + \sum_c f_c + \sum_t f_t + \sum_c f_c \times \tau + \sum_c f_c \times \tau^2 + \epsilon_{c,t}, \quad (2)$$

where we follow the specification in Friedberg (1998) and Piazzalunga (2017) and allow (in the most general specification) a country-specific quadratic time trend.

3 Model

In this section, we will describe our model of household decision making over the lifecycle. We will assume that married individuals make decisions about consumption, housing demand and labor supply under *limited commitment*, which implies that the household maximizes a weighted sum of utility functions of both spouses, where the weights reflect relative bargaining power of each spouse, but they cannot commit to future allocations. Hence, the bargaining weights are

[14] Note that the subscript c stands for 'country' where we have either c = England/Wales or c = Scotland.

allowed to be renegotiated in each period as a function of whether or not the individual might become better off outside of marriage. In particular, if one spouse's expected utility outside of marriage is higher than the (expected) utility of staying married there will be a shift of future resource allocations such that both spouses are better off staying together. If this is not possible, they choose to separate and the marriage dissolves. Given these features, the model is clearly well-suited to tackle questions regarding how changes in post-divorce asset division (e.g. in the case of *White v. White*) affects household behavior through changes in bargaining power and how the presence of leverage-based borrowing constraints (pertaining to the housing choice) affect the influence of changes in outside options on household behavior.

3.1 Timing in the model

We study people making decisions over their lifecycle. Time is discrete and will be indicated by a subscript t. The lifecycle is divided into two phases, the working phase ($t \leq T_r$) and a retirement phase ($T_r < t \leq T_d$). During the working phase, when married, individuals make joint decisions on private consumption, time and money spent producing a household-level public good, working hours on the labor market and housing status (i.e., whether to rent or buy a house). Furthermore, individuals within marriage can choose (unilaterally) to separate from their spouse, after which they will remain single for the remainder of their lifecycle. At the end of the working phase, people enter retirement and only have to make consumption, housing and saving decisions until their death ($t = T_d$), i.e., there are no time allocation choices made during retirement. We now proceed with discussing the different parts of the model after which we can formally state the household optimization problem.

3.2 Preferences, match quality and technology

We study couples consisting of a male and a female spouse (resp.M and F), who in each period t, make decisions over private consumption levels c_t^M, c_t^F, female labor supply, n_t^F, housing, which is measured in levels corresponding to the *size of the house*, $H_t \in \{0, 1, ..., \bar{H}\}$, where $\bar{H}$ is the largest possible house, while $H_t = 0$ denotes the decision to rent. The level of savings of the household is indicated by A_t. With respect to private consumption, we follow Voena (2015) and assume that households are characterized by economies of scale, in particular:

$$x_t = F\left(c_t^M, c_t^F\right) = \left[\left(c_t^M\right)^\rho + \left(c_t^F\right)^\rho\right]^{\frac{1}{\rho}} \tag{3}$$

If $\rho \geq 1$, then this functional form implies that the spouses can consume more jointly, by living together, than they would if each of them lived separately.

The utility of a married male is then given by

$$u^M\left(c_t^M, H_t, \theta_t\right) = \frac{(c_t^M)^{1-\sigma^M}}{1-\sigma^M} + \mathbf{1}\left[H_t > 0\right]\omega_H^M\left(t\right) + \theta_t. \tag{4}$$

Notice that we do not include the male spouse's labor supply, since we assume that he works full time until retirement.[15] Housing is a public good and yields a time varying marginal utility, which is equal to $\omega_H(t)$. This captures life-cycle effects (e.g. changing preferences due to fertility episodes and subsequent changes in the average household size). In particular, we assume:

$$\omega_H^M\left(t\right) = \bar{\omega}_H^M \times \left(1.7 + 0.5 \times \mathit{children}_t\right), \text{ and} \tag{5}$$

$$\bar{\omega}_H^M = \omega_{H,0}^M + \omega_{H,1}^M \frac{\bar{H}-1}{H-1} \tag{6}$$

where $\omega_{H,0}^M$ captures the male's preference for a small house, whereas $\omega_{H,1}^M$ is

[15] Though we do allow for variation in hours worked over the lifecycle through (exogenous) job displacement shocks, cfr. infra.

the marginal utility he derives from owning a larger-sized house. Note that the preferences for housing are allowed to evolve over the lifecycle, in function of household size. The latter is captured by the term $children_t$, which denotes the average number of children in a household of age t.[16]

The term θ_t in the expression for the husband's utility measures match quality, capturing the non-material benefits ('love') from marriage. This match quality is considered as a shock and is assumed to follow a unit root process, i.e.,

$$\theta_t = \theta_{t-1} + \epsilon_t, \tag{7}$$

where $\epsilon_t \sim N\left(0, \sigma_\theta^2\right)$.

Married women derive a flow utility given by,

$$u^F\left(c_t^F, l_t^F, H_t, \theta_t\right) = \frac{\left(c_t^F\right)^{1-\sigma^F}}{1-\sigma^F} + \omega_l^{F,m}\frac{\left(l_t^F\right)^{1-\psi^F}}{1-\psi^F} + \mathbf{1}\left[H_t > 0\right]\omega_H^F\left(t\right) + \theta_t. \tag{8}$$

A married woman her preferences are very similar to married men, with a few notable differences. First, given that female labor supply is variable in our model, there is an additional term entering (8), in particular her pertaining to preferences over leisure, $l_t^F = 1 - n_t^F$.[17] Next, we allow for differences in the preferences over home ownership between men and women, more specifically, we allow for the coefficients $\omega_{H,0}^F$ and $\omega_{H,1}^F$ governing the utility of homeownership, $\omega_H^F\left(t\right)$, to be different than the parameters in $\omega_H^M\left(t\right)$.

Single men and women are very similar to their resp. married counterparts. Specifically, the utility of a single man is given by:

[16] We follow Pizzinelli (2018) and use an equivalization coefficient, based on the following OECD scale: the first adult in the household gets a weight of 1, the second a weight of 0.7 and every child gets a weight of 0.5.

[17] We chose to not include household work as a choice variable, both for computational reasons, but also given that for identification purposes, there is no empirical evidence that women have substituted market work for domestic work after the *White v. White* reform. We refer the reader to table 30 in the Appendix.

$$u^{M,s}\left(c_t^M, H_t\right) = \frac{(c_t^M)^{1-\sigma^M}}{1-\sigma^M} + \mathbf{1}\left[H_t > 0\right]\bar{\omega}_H^M, \tag{9}$$

And for a single woman:

$$u^{F,s}\left(c_t^F, l_t^F, H_t\right) = \frac{(c_t^F)^{1-\sigma^F}}{1-\sigma^F} + \omega_l^{F,s}\frac{(l_t^F)^{1-\psi^F}}{1-\psi^F} + \mathbf{1}\left[H_t > 0\right]\bar{\omega}_H^F. \tag{10}$$

Some remarks are in order. First, notice that we assume preferences for housing status and housing size are the same for married and single individuals (within the same gender), conditional on observable differences pertaining to household size (in particular, number of dependent children). Furthermore, we allow for differences in the relative utility weight for leisure between single and married women.

3.3 Wages, earnings and unemployment shocks

Besides match quality ('love') shocks, the other main source of uncertainty in our model consists of income and wage shocks. In particular, we assume:

$$\ln y_t^M = \alpha^M(t) + \nu_t^M, \tag{11}$$

for the earnings process of males and

$$\ln w_t^F = \alpha^F(t) + \nu_t^F, \tag{12}$$

which describes the wage process for women. Men work full time over the entire working phase of the lifecycle ($t \leq T_r$), however, following Pizzinelli (2018), we assume that in each period they face the risk of becoming (involuntarily) unemployed with an associated probability π_u. When unemployed they receive an unemployment benefit given by b_u.[18] Both men and women face a concave

[18]To simplify the analysis, we assume that the probability of becoming unemployed in each period is independent of the employment status in the previous period. We leave a full analysis

lifecycle profile in earnings (or wages) given by $\alpha^i(t)$, $i = M, F$, where

$$\alpha^i(t) = \alpha^i_1 t + \alpha^i_2 t^2,$$

and permanent productivity shocks, ν^i_t, $i = M, F$. These permanent shocks reflect shock in productivity, health etc. Following Blundell et al. (2008), we assume that these follow a random walk:

$$\nu^i_t = \nu^i_{t-1} + \varepsilon^i_t, \; i = M, F \tag{13}$$

Furthermore, we allow for correlation in spouses' permanent shocks. In particular, $\varepsilon_t = \left(\varepsilon^M_t, \varepsilon^F_t\right) \sim N\left(\mu_\varepsilon, \Sigma_\varepsilon\right)$,

$$\mu_\varepsilon = \left(-\frac{\sigma^2_{\varepsilon^M}}{2}, -\frac{\sigma^2_{\varepsilon^F}}{2}\right)$$

and

$$\Sigma_\varepsilon = \begin{pmatrix} \sigma^2_{\varepsilon^M} & \sigma_{\varepsilon^M,\varepsilon^F} \\ \sigma_{\varepsilon^M,\varepsilon^F} & \sigma^2_{\varepsilon^F} \end{pmatrix}$$

Such correlation in spouses' income shocks is especially important in the context of the present model, given that we do not explicitly model assortative matching in the marriage market, which typically leads to intra-household correlation of income shocks and has important consequences for intra-household inequality as a factor for more general patterns in the evolution of income inequality (e.g. Fernández and Rogerson (2001), Lise and Seitz (2011), Eika et al. (2019) and Chiappori et al. (2020)) , given that people match on education and hence might choose similar occupations or have similar labor market skills, which are subsequently sensitive to similar shocks. In retirement, individuals no longer work

allowing for unemployment persistence and the impact of subsequent human capital depreciation and household income for future research.

and no longer face earnings shocks. Instead of their labor income, they receive a pension, y_r, which is defined as a replacement rate, b_r which is multiplied by the earnings in the last period in which the individual was working.

3.4 Budget and borrowing constraints

We now discuss the constraints which the household faces each period. To start, the budget constraint facing spouses is given by

$$A_t + x_t + pH_t + \Omega\left(H_t, H_{t-1}\right) + q\mathbf{1}\left[H_t = 0\right] = \left(1+R\right)A_{t-1} + y_t^M e_t^M$$

$$+b_u\left(1-e_t^M\right) + w_t^F n_t^F - \delta^m\left(t\right)\mathbf{1}\left[n_t^F > 0\right] + pH_{t-1}, \tag{14}$$

Married spouses choose savings A_t, expenditures on consumption, x_t, and they also make housing decisions. For the latter, they choose whether or not to buy a house and about the size of the house in case they buy. Renting costs are equal to q, house prices are given by $p_1, ..., p_{\bar{H}}$. Income resources for the household are equal to the incomes of husband and wife (if she works, $n_t^F > 0$) and returns on savings from the past period. Income for the husband is given by his labor income, y_t^M, in case he works ($e_t^M = 1$), whereas he receives an unemployment benefit, b_u in case he is (involuntarily) unemployed in period t, i.e., $e_t^M = 0$. Notice that the variable e_t^M is an i.i.d Bernouilli random variable, with $Pr\left(e_t^M = 0\right) = \pi_u$ and $Pr\left(e_t^M = 1\right) = 1 - \pi_u$.

Women earn an hourly wage in period t given by w_t^F and consequently her earnings is given by $w_t^F \times n_t^F$. Furthermore, we incorporate a cost of working for women which we express in monetary terms as given by the term $\delta^m(t) = \delta_1^m t + \delta_2^m t^2$, where we use the same functional form as in Pizzinelli (2018) and Borella et al. (2018). Notice that wealth effects from housing stock are captured by the change in housing values and housing status. Furthermore, when a household decides to change housing status (either change the size of the house or change tenure), they face a transaction cost given by $\Omega(H_t, H_{t-1})$. An important aspect of our model is that households face leverage-based borrowing constraints, i.e., the amount of debt they can accumulate is determined by the housing status. In particular, we assume:

$$
\begin{aligned}
-A_t &\leq \Upsilon^{\text{Mar}}\left(H_{t-1}, H_t, n_t^F, A_{t-1}\right), \\
&= \max\left\{-A_{t-1}, \min\left\{\lambda_H p, \left(\lambda_y\left[y_t^M e_t^M + b_u\left(1-e_t^M\right)\right] + n_t^F \times w_t^F\right)\right\}\right\}. \quad (15)
\end{aligned}
$$

We follow Bottazzi et al. (2007) and Pizzinelli (2018) in assuming that net liquid savings constitutes a single continuous variable and hence we do not allow for a separate choice of mortgage contract and deposits. Obviously, in reality households hold both positive liquid assets and mortgage debt, but decoupling these would significantly add to the computational complexity of our model, by doubling the continuous dimension of the state space.[19]

We now describe the budget and borrowing constraints facing singles and divorcees in our model First, single women face the following budget constraint:

$$
\begin{aligned}
A_t + c_t^F + pH_t + \Omega(H_t, H_{t-1}) + q\mathbf{1}[H_t = 0] &= (1+R)A_{t-1} \\
&+ w_t^F n_t^F - \delta^s(t)\mathbf{1}\left[n_t^F > 0\right] + pH_{t-1}, \quad (16)
\end{aligned}
$$

[19]Our focus on illiquid assets such as housing and neglecting the diversity in the household balance sheet through different sorts of liquid assets might be justified by a renewed focus recently on so-called "wealthy hand-to-mouth"-type consumers. These are consumers with large illiquid assets (such as housing), but relatively low amounts of liquid assets. This has direct consequences for example in the context of macroeconomic stabilization policies, see Kaplan et al. (2014), Kaplan and Violante (2014), Kaplan et al. (2018). We do also refer the reader to Druedahl (2015), who studies portfolio allocation on different types of assets, but in the context of a unitary model and excluding divorce.

where we allow for different monetary cost of participating on the labor market, compared to their married counterparts. For single males, their budget constraint is given by the following:

$$A_t+c_t^M+pH_t+\Omega\left(H_t,H_{t-1}\right)+q\mathbf{1}\left[H_t=0\right]=\left(1+R\right)A_{t-1}+y_t^Me_t^M+b_u\left(1-e_t^M\right)+pH_{t-1}, \tag{17}$$

The borrowing constraint for singles is also similar to (15), in particular:

$$\begin{aligned} -A_t \leq & \quad \Upsilon^{\text{Div}}\left(H_{t-1},H_t,n_t^F,A_{t-1}\right), \\ & = \max\left\{-A_{t-1},\min\left\{\lambda_H p,\lambda_y w_t^F n_t^F\right\}\right\}, \end{aligned} \tag{18}$$

for single women and

$$\begin{aligned} -A_t \leq & \quad \Upsilon^{\text{Div}}\left(H_{t-1},H_t,n_t^F,A_{t-1}\right), \\ & = \max\left\{-A_{t-1},\min\left\{\lambda_H p,\lambda_y\left[y_t^Me_t^M+b_u\left(1-e_t^M\right)\right]\right\}\right\}, \end{aligned} \tag{19}$$

for single men. The main difference between (15) and either (18) or (19) is the absence of a second earner, which implies that the loan-to-income borrowing limit becomes more stringent compared to married individuals, who have an additional source of income through their spouse's labor income. We refer to Section 4 for a detailed discussion pertaining to how we estimate the income and wage processes. In the retirement phase the budget and borrowing constraints are very similar, with the difference that, instead of their earnings, individuals now receive their retirement income y_r^i, $i=M,F$. Specifically, for a retired couple:

$$A_t + x_t + pH_t + \Omega\left(H_t, H_{t-1}\right) + q\mathbf{1}\left[H_t = 0\right] = \left(1+R\right)A_{t-1} + y_r^M$$

$$+y_r^F + pH_{t-1}. \tag{20}$$

And the same equivalent budget constraints for singles (divorcees),in particular:

$$A_t + c_t^F + pH_t + \Omega\left(H_t, H_{t-1}\right) + q\mathbf{1}\left[H_t = 0\right] = \left(1+R\right)A_{t-1}$$

$$+y_r^F + pH_{t-1}, \tag{21}$$

for single retired women and

$$A_t + c_t^M + pH_t + \Omega\left(H_t, H_{t-1}\right) + q\mathbf{1}\left[H_t = 0\right] = \left(1+R\right)A_{t-1} + y_r^M + pH_{t-1}, \tag{22}$$

for single retired men. The borrowing constraints for retirees are also similar to those in the working phase, with the difference that the LTI limit is now completely exogenous due to the absence of the secondary earner's labor supply.

3.5 Optimization problems

We start with formulating the couple's optimization problem. The household maximizes a weighted sum of utilities of the spouses, under the added restriction that each spouse must, in each period, be better off inside marriage than divorcing and becoming single. In practice, this means that the bargaining (Pareto) weights evolve as a function of changes in the outside options available for both spouses. An important consequence of this assumption is that the Pareto weights will become state variables in the dynamic optimization problem (Voena, 2015). More formally, let $\mathbf{S}_t = \left(A_{t-1}, H_{t-1}, w_t^F, y_t^M, \theta_t, \tilde{\mu}_t^M, \tilde{\mu}_t^F\right)$ denote all the relevant state variables which the household takes into account in making decisions over choice variables in period $t \leq T_r$. This comprises the asset (debt) carried over from the last period, the housing status with which the household enters period t, the wife's wage, the husband's income and the current split of resources within the household (i.e., the Pareto weights.) In the retirement phase, the state space can be reduced since income becomes fully deterministic and can therefore be removed from $\mathbf{S}_t$ for $T_r < t \leq T_d$. We will denote by $\mathbf{a}_t = \left(c_t^M, c_t^F, n_t^F, A_t, H_t, D_t\right)$ all the choices made by the household in any period t during the working phase. The couple then solves the following problem:

$$
\begin{aligned}
V_t\left(\mathbf{S}_t\right) \quad &= \max_{\mathbf{a}_t}\left(1-D_t\right)\left\{\tilde{\mu}_t^M u^M\left(c_t^M, H_t; \theta_t^M\right)+\tilde{\mu}_t^F u^F\left(c_t^F, n_t^F, H_t; \theta_t^F\right)\right. \\
&\left. +\beta \mathbb{E}\left[V_{t+1}\left(\mathbf{S}_{t+1} | \mathbf{S}_t\right)\right]\right\} \\
&+D_t\left\{\tilde{\mu}_t^M\left[u^M\left(c_t^M, H_t\right)+\beta \mathbb{E}\left[V_{t+1}^{M,d}\left(\mathbf{S}_{t+1} | \mathbf{S}_t\right)\right]\right]\right. \\
&\left.+\tilde{\mu}_t^F\left[u^F\left(c_t^F, n_t^F, H_t\right)+\beta \mathbb{E}\left[V_{t+1}^{F,d}\left(\mathbf{S}_{t+1} | \mathbf{S}_t\right)\right]\right]\right\}, \qquad (23)
\end{aligned}
$$

subject to budget and borrowing constraints in marriage, (14) and (15) and the dynamics of the Pareto weights,

$$\tilde{\mu}_{t+1}^M = \tilde{\mu}_t^M + \xi_t^M, \text{ and } \tilde{\mu}_1^M = \mu, \qquad (24)$$

$$\tilde{\mu}_{t+1}^F = \tilde{\mu}_t^F + \xi_t^F, \text{ and } \tilde{\mu}_1^F = 1-\mu. \qquad (25)$$

in case $D_t = 0$. For the case where $D_t = 1$, the budget and borrowing constraints under divorce, (16) or (17) and (18) or (19) must be satisfied and joint assets (in particular, housing wealth) are split between the spouses (cfr. infra).

The parameters $\tilde{\mu}_t^i$, $i = M, F$ ensure that the following participation constraints are always satisfied in marriage (whenever $D_t = 0$),

$$u^M \left(c_t^M, H_t; \theta_t\right) + \beta \mathbb{E} \left[V_{t+1}^M \left(\mathbf{S}_{t+1} | \mathbf{S}_t\right)\right] \geq V_t^{M,d} \left(\mathbf{S}_t^{M,s}\right), \tag{26}$$

$$u^F \left(c_t^F, n_t^F, H_t; \theta_t\right) + \beta \mathbb{E} \left[V_{t+1}^F \left(\mathbf{S}_{t+1} | \mathbf{S}_t\right)\right] \geq V_t^{F,d} \left(\mathbf{S}_t^{F,s}\right). \tag{27}$$

Where $\mathbf{S}_t^{M,s} = \left(A_{t-1}, H_{t-1}, y_t^M\right)$ are the relevant state variables for a single male and similarly, $\mathbf{S}_t^{F,s} = \left(A_{t-1}, H_{t-1}, w_t^F\right)$ contain the relevant state variables for a single woman at the start of period t. Now we remark that ξ_t^i $i = M, F$ correspond to the Lagrange multipliers associated with each spouse's sequential participation constraint (26)-(27), cfr. Marcet and Marimon (2019). A solution involves a mapping from the state variables to decisions, i.e.,

$$\mathbf{a}^* \left(\mathbf{S}_t\right) = \left(c_t^{M*} \left(\mathbf{S}_t\right), c_t^{F*} \left(\mathbf{S}_t\right), n_t^{F*} \left(\mathbf{S}_t\right), H_t^* \left(\mathbf{S}_t\right), D_t^* \left(\mathbf{S}_t\right)\right). \tag{28}$$

Given these, each spouse's value of marriage is then equal to:

$$V_t^{i,m} \left(\mathbf{S}_t\right) = u^F \left(c_t^{i*} \left(\mathbf{S}_t\right), n_t^{i*} \left(\mathbf{S}_t\right), H^* \left(\mathbf{S}_t\right); \theta_t\right) + \beta \mathbb{E} \left[V_{t+1}^i \left(\mathbf{S}_{t+1} | \mathbf{S}_t\right)\right]. \tag{29}$$

The choices made during the retirement phase, $t > T_r$ are simplified due to the absence of labor supply decisions for the secondary earner.[20]

Similar to Voena (2015), we can compute the continuation value through

[20]Though the retirement phase is over-simplified, the inclusion of retirement to our model is very important for its empirical performance. Indeed, without having a retirement phase, it would be very difficult to explain both labor supply profiles and homeownership rates, given that both are useful in the retirement phase as a source of savings and income which allows for sufficiently high consumption after the active part of the lifecycle for individuals.

backwards recursion, in particular, for the terminal period we have:

$$V_T^i(\mathbf{S}_t) = (1 - D_T^*) V_T^{i,m} + D_T^* V_T^{i,d},$$

where $V_T^{i,m} = u^i\left(c_T^{i,*}(\mathbf{S}_T), n_T^{i,*}(\mathbf{S}_T), H_T^*(\mathbf{S}_T); \theta_T\right)$, and

$$V_T(\mathbf{S}_T) = \tilde{\mu}_T^M V_T^M(\mathbf{S}_T) + \tilde{\mu}_T^F V_T^F(\mathbf{S}_T).$$

And the same for the remaining periods, $t < T$.

To conclude the description of the model, we describe the problem for divorcees and singles. Single men decide on savings (debt) levels, consumption and housing. Single women make the same choices and also decide on their labor supply, summarizing: $\mathbf{a}^{M,s} = \left(c_t^M, A_t, H_t\right)$ and $\mathbf{a}^{F,s} = \left(c_t^F, n_t^F, A_t, H_t\right)$. The optimization problem for a single man simply reads:

$$V_t^{M,s}\left(\mathbf{S}_t^{M,s}\right) = \max_{\mathbf{a}_t^{M,s}} u^{M,s}\left(c_t^M, H_t\right) + \beta\mathbb{E}\left[V_{t+1}^{M,s}\left(\mathbf{S}_{t+1}^{M,s}\right)\right], \tag{30}$$

subject to (17) and (19). The equivalent dynamic optimization problem for a single woman reads:

$$V_t^{F,s}\left(\mathbf{S}_t^{F,s}\right) = \max_{\mathbf{a}_t^{F,s}} u^{F,s}\left(c_t^F, H_t\right) + \beta\mathbb{E}\left[V_{t+1}^{M,s}\left(\mathbf{S}_{t+1}^{M,s}\right)\right], \tag{31}$$

subject to (16) and (18). It should be noted that, in contrast to Voena (2015), we assume that divorce is an absorbing state and therefore, we do not allow for remarriage. If $D_t = 1$ the divorcees therefore solve the same problem as singles, with the further restriction that the assets with which each divorcee starts the next period, A_{t-1}^i, $i = M, F$ (and where $A_t^M + A_t^F = A_t$) is obtained through a division rule of joint assets. More precisely,

$$
\begin{aligned}
A_t^M &= \tfrac{y_0^M}{y_0^M + w_0^F \times \bar{n}^F} A_t, \text{ and} \\
A_t^F &= \left(1 - \tfrac{y_0^M}{y_0^M + w_0^F \times \bar{n}^F}\right) A_t.
\end{aligned} \tag{32}
$$

Where $y_0^M (w_0^F)$ denote the initial earnings of the husband (res. wife) and $\bar{n}^F$ denotes an average level of women's labor supply. This is clearly a simplification, mostly due to a lack of information and good data on either individualized wealth or any voluntary ex-post settlements between (former) spouses. We treat (potential) earnings for spouses at the start of individuals their lifecycle as a proxy for their potential wealth accumulation. This motivates the use of (32) as a splitting rule for net wealth post-divorce.

4 Identification and Estimation

We now turn to details regarding the estimation of all the components in our model. To streamline the exposition, we will divide the parameters in our model, collected in Θ, in three categories: (i) the parameters that are estimated within the model (Θ^{int}), (ii) the parameters that are estimated externally (Θ^{ext}) and (iii) the pre-set parameters, Θ^{ps}, with values taken from the literature or calibrated to match specific values in the literature.

4.1 Parameters estimated within the model

The first category of parameters are those which we estimate within the model. This vector of parameters, $\Theta^{int} \subset \Theta$ consists of the following,

$$
\Theta^{int} = \left((\sigma_\theta^M)^2, (\sigma_\theta^F)^2, \tilde{\mu}_0^M, \omega_n^{F,m}, \omega_n^{F,s}, \delta_1^m, \delta_2^m, \delta_1^s, \delta_2^s, \omega_{H,0}^M, \omega_{H,1}^M, \omega_{H,0}^F, \omega_{H,1}^F\right),
$$

that is, the variance of match quality shocks, the initial intra-household bargaining power, the relative weight on leisure in the women's utility (for both married and single women), the monetary cost parameters for working for women and the marginal utility parameters for housing for men and women. The vector Θ^{int} is estimated using indirect inference. This implies that we will use an auxiliary model to estimate our main model. Specifically, the auxiliary model consists of the following equations:

(i) The change in working hours due to the *White v. White* case (married women between 18 and 55 years old), $\hat{\phi}_1$, estimated from (1), with $Y = Hours$.

(ii) The average employment rates of women across different age ranges $\hat{\phi}_2$-$\hat{\phi}_6$, obtained from:

$$employment_{i,c,r,t} = \phi_2 + \epsilon_{2,i,c,r,t}, \text{ for women 25-29 yo} \quad (33)$$

$$employment_{i,c,r,t} = \phi_3 + \epsilon_{3,i,c,r,t}, \text{ for women 30-34 yo} \quad (34)$$

$$employment_{i,c,r,t} = \phi_4 + \epsilon_{4,i,c,r,t}, \text{ for women 35-39 yo} \quad (35)$$

$$employment_{i,c,r,t} = \phi_5 + \epsilon_{5,i,c,r,t}, \text{ for women 40-44 yo} \quad (36)$$

$$employment_{i,c,r,t} = \phi_6 + \epsilon_{6,i,c,r,t}, \text{ for women 45-49 yo} \quad (37)$$

(iii) Average hours worked by married women in the labor market, across different age ranges, $\hat{\phi}_7$-$\hat{\phi}_{11}$,

$$Hours_{i,c,r,t} = \phi_7 + \epsilon_{7,i,c,r,t}, \text{ for married women 25-29 yo} \tag{38}$$

$$Hours_{i,c,r,t} = \phi_8 + \epsilon_{8,i,c,r,t}, \text{ for married women 30-34 yo} \tag{39}$$

$$Hours_{i,c,r,t} = \phi_9 + \epsilon_{9,i,c,r,t}, \text{ for married women 35-39 yo} \tag{40}$$

$$Hours_{i,c,r,t} = \phi_{10} + \epsilon_{10,i,c,r,t}, \text{ for married women 40-44 yo} \tag{41}$$

$$Hours_{i,c,r,t} = \phi_{11} + \epsilon_{11,i,c,r,t}, \text{ for married women 45-49 yo} \tag{42}$$

(iv) Average hours worked by single women in the labor market, across different age ranges, $\hat{\phi}_{12}$-$\hat{\phi}_{16}$,

$$Hours_{i,c,r,t} = \phi_{12} + \epsilon_{12,i,c,r,t}, \text{ for single women 25-29 yo} \tag{43}$$

$$Hours_{i,c,r,t} = \phi_{13} + \epsilon_{13,i,c,r,t}, \text{ for single women 30-34 yo} \tag{44}$$

$$Hours_{i,c,r,t} = \phi_{14} + \epsilon_{14,i,c,r,t}, \text{ for single women 35-39 yo} \tag{45}$$

$$Hours_{i,c,r,t} = \phi_{15} + \epsilon_{15,i,c,r,t}, \text{ for single women 40-44 yo} \tag{46}$$

$$Hours_{i,c,r,t} = \phi_{16} + \epsilon_{16,i,c,r,t}, \text{ for single women 45-49 yo} \tag{47}$$

(v) Average home ownership rates for married and single individuals $\hat{\phi}_{17}, \hat{\phi}_{19}$:

$$Homeownership_{i,c,r,t} = \phi_{17} + \epsilon_{17,i,c,r,t}, \text{ for married individuals 30-50 yo} \tag{48}$$

$$Homeownership_{i,c,r,t} = \phi_{18} + \epsilon_{18,i,c,r,t}, \text{ for single men 30-50 yo,} \tag{49}$$

$$Homeownership_{i,c,r,t} = \phi_{19} + \epsilon_{19,i,c,r,t}, \text{ for single women 30-50 yo,} \tag{50}$$

(vi) Average housing value (p), $\hat{\phi}_{20}, \hat{\phi}_{21}$,

$$Housingvalue_{i,c,r,t} = \phi_{20} + \epsilon_{20,i,r,t}, \text{ for married individuals 30-50 yo} \quad (51)$$

$$Housingvalue_{i,c,r,t} = \phi_{21} + \epsilon_{21,i,c,r,t}, \text{ for singles 30-50 yo} \quad (52)$$

(vii) Average (crude) divorce rate before the reform, $\hat{\phi}_{22}$,

$$Divorce_{c,t} = \phi_{22} + \epsilon_{10,c,t}, \quad (53)$$

(viii) Response of divorce rates to *White v. White* case, $\hat{\phi}_{23}$, obtained as an estimate from $\tilde{\phi}$ in (2).

Let $\phi = (\phi_1, ..., \phi_{23})$. Under the assumption we have already pre-estimated and/or calibrated the parameters in Θ (those which we don't estimate within the model, cfr. infra), we need to set values for Θ^{int} in order to completely solve and simulate the dynamic model of household behavior. In particular, we simulate paths of permanent productivity and match quality shocks and use the policy functions (28) to generate simulated paths of household behavior. We also simulate the model for when the divorce law (i.e., the post-divorce division rule, (32)) changes at a stage in the lifecycle which matches the average age profile for individuals confronted by the *White v. White* case in the data.[21]

We can then run the regressions defining the auxiliary model on the simulated data and obtain values $\phi^{sim}(\Theta^{int}) = (\phi_1^{sim}, ..., \phi_{23}^{sim})$. Let ϕ^{data} denote the corresponding values for ϕ from estimating the auxiliary model on the real dataset. Indirect inference then implies the optimal estimate for Θ^{int}, denoted as $\hat{\Theta}^{int}$ is picked as follows:

[21] This is the same approach as pursued in Voena (2015). We also follow Voena and more generally the literature in making the assumption that the change in the post-divorce division rule of assets is not anticipated by individuals and therefore completely unexpected.

$$\hat{\Theta}^{int} = \arg\min_{\Theta^{int}} \left(\phi^{sim}\left(\Theta^{int}\right) - \phi^{data}\right) W \left(\phi^{sim}\left(\Theta^{int}\right) - \phi^{data}\right)', \tag{54}$$

where W is a symmetric and positive (semi-)definite weighting matrix.[22]

4.2 Heuristic identification argument

A typical feature for indirect inference approaches to estimation, is that the choice of the auxiliary model is such that each parameter to be matched from the auxiliary model, i.e., ϕ is informative with respect to the values of the parameter vector of interest, Θ^{int}. To be more specific, ϕ_1, and ϕ_{23} both help to identify the initial bargaining power, $\tilde{\mu}_0$. Indeed, both auxiliary parameters indicate how the household responds to a change in the division rule of assets post-divorce. For values of $\tilde{\mu}_0$ that are substantially larger compared to relative permanent incomes, the possibility for the household to reallocate resources is larger and therefore, we should expect a larger response in women's reduction of working hours and also decreases the chance that there are no reallocations of future resources such that the wife's participation constraint would be binding.[23]

The parameters (33)-(37) capture the hump-shaped lifecycle pattern of female labor supply (particularly at the extensive margin), cfr. figure 1a, which is determined mostly through the cost of working, $\delta(t)$. Indeed, more concave profiles for the cost of working $\delta(t)$ will force a hump shape pattern in female labor supply. Average hours worked by married and single women across different age ranges, $\phi_7 - \phi_{16}$ equally helps us with non-linear patterns in female labor supply on the intensive margin, but in addition add to the identification of the relative preferences for leisure, $\omega_n^{F,m}$ and $\omega_n^{F,s}$ of women. Indeed, for lower values

[22] We opted for the optimal weighting matrix, which coincides with the inverse of the variance-covariance matrix for the parameters of the auxiliary model, i.e., $W = \Sigma_\phi^{-1}$.

[23] This argument is also very similar to the analysis in Newman and Olivetti (2015), where they show that two-earner households can be more durable due to greater flexibility in terms of resources to reallocate such that both spouses are better off inside the marriage.

of $\omega_n^{F,m}$ (resp. $\omega_n^{F,s}$) the average hours worked by married (resp. single) women will be higher and for larger values of $\omega_n^{F,m}$ (resp.$\omega_n^{F,s}$), married (resp. single) women enjoy a higher utility of leisure, thereby depressing labor supply, ceteris paribus.

The value of $(\sigma_\theta^i)^2$ $(i = M, F)$, i.e., the variance of the match quality shocks, influences the likelihood of divorce. Higher volatility in match quality shocks imply a larger probability that spouses would prefer to divorce each other, hence there is a theoretical link between $(\sigma_\theta^i)^2$ and the average divorce rate, as given in the auxiliary model by ϕ_{22}.

Finally, higher values for $\omega_{H,0}^i$, $(i = M, F)$ will increase the likelihood of households buying a house, hence this parameter can be identified using homeownership rates for couples, $\phi_{17} - \phi_{19}$. The preferences over size of housing, $\omega_{H,1}^i$ $(i = M, F)$ can be identified by the average housing values ϕ_{20}, ϕ_{21}. Also notice that the inclusion of the average number of children in a household as a preference shifter for $\omega_H^i(t)$ $(i = M, F)$ also allows us to fit the concave profile of homeownership rates across the lifecycle.

4.3 Externally estimated parameters

The parameters which are estimated outside of the model, Θ^{ext}, consist in the deterministic profiles for earnings and wages, $\alpha_1^M, \alpha_2^M, \alpha_1^F, \alpha_2^F$ and the variance of the income processes, $\sigma_{\varepsilon^M}^2$ and $\sigma_{\varepsilon^F}^2$. The deterministic age-profiles can be estimated simply by running a regression of (log) earnings for men and (log) wages for women on age, age squared and other controls. We also control for selection into the labor market of women, using a Heckman 2-step correction estimation.[24] The identification of the variances of the permanent shocks is based on the second moments of the growth rates of income and wages and is standard in the literature (Meghir and Pistaferri, 2004; Blundell et al., 2008), in

[24] Full details on these estimations are contained in the Appendix, see F.

particular, if we define

$$\tilde{y}_t^M = y_t^M - \alpha^M(t)$$

and

$$\tilde{w}_t^F = w_t^F - \alpha^F(t)$$

then we can recover the unexplained parts of earnings and wages, in particular,

$$\Delta\tilde{y}_t^M = \epsilon_t^M,$$

and

$$\Delta\tilde{w}_t^F = \epsilon_t^F.$$

The variance of the innovations ϵ_t^M for men's productivity can then be identified using a single second moment[25], more specifically:

$$\sigma_{\epsilon^M}^2 = Cov\left(\Delta\tilde{y}_t^M, \Delta\tilde{y}_{t-1}^M + \Delta\tilde{y}_t^M + \Delta\tilde{y}_{t+1}^M\right), \tag{55}$$

and a similar strategy applies to identify the variance of innovations to women's wages:

$$\sigma_{\epsilon^F}^2 = Cov\left(\Delta\tilde{w}_t^F, \Delta\tilde{w}_{t-1}^F + \Delta\tilde{w}_t^F + \Delta\tilde{w}_{t+1}^F\right), \tag{56}$$

The equations (55) and (55) can be directly estimated from panel data on female wages and male earnings, after removing the age-profiles from the wage and earnings dynamics.

4.4 Preset parameters

The remaining parameters of the model, including the discount rate, the credit market parameters etc. are calibrated using estimated values found in the liter-

[25] Notice that these results can be generalized to allow for serially uncorrelated transitory shocks in the income processes.

ature or calibrated to match specific empirical targets. We will briefly discuss this set of calibrated parameters, which are collected in the vector Θ^{ps}.

Discount factor, preference parameters. For the CRRA parameters we set $\sigma^M = \sigma^F = 2$ and for the discount factor we choose $\beta = 0.95$, which are typical values in the literature. Similar to Pizzinelli (2018), we set $\psi^F = 6.19$, implying a Frisch elasticity of labor supply of 0.3.

Initial assets. Given the general lack of good wealth information, we start the model for individuals aged 20 years old with no assets and starting out as renters. However, given that most of the (targeted) empirical moments apply to the age range of 30 and above, we allow individuals to accumulate some wealth before the main period in the lifecycle under analysis.

Housing market parameters. We assume 4 levels of housing size, that is $\bar{H} = 4$. For the associated housing prices, we use available data on (self-reported) housing values in the BHPS and normalize its distribution by the average yearly income of (working) males in 2001 (as the midpoint in our main sample range, 1994-2008.) The prices are then resp. given by the 25th, 45th, 65th and 85th percentile of the resulting (normalized) housing value distribution. This gives us the following values: $p_1 = 3.17, p_2 = 4.34, p_3 = 6.22, p_4 = 10.95$. For the renting cost we follow Pizzinelli (2018) and select a value which is 1 % of the housing value in the 85th percentile, which gives $q = 0.11$. Following Attanasio et al. (2012), we assume the same transaction cost for buying or selling a house and set its value to $F = 0.05$, i.e., 5 % of the price of the house has to be paid in (administrative and other) costs. This value is in between the transaction cost of selling (=7 %) and buying (=2.5 %) as set in Yang (2009). Regarding the leverage-based constraints, we set $\lambda_H = 0.9$, which implies households need to make a downpayment of 10 % of the house value when buying a house. For the LTI limit, we pick $\lambda_y = 3$, which is the same as in Pizzinelli (2018) who uses the Financial Services Authority their 2004 *Guide to Mortgages* as a source for this value.

Labor market parameters. The parameters $\sigma^2_{\epsilon^M}$ and $\sigma^2_{\epsilon^F}$ are directly estimated outside the model (for details, see F). The correlation between the productivity shocks among spouses, $\sigma_{\varepsilon^M,\varepsilon^F}$ is set to 0.25, which is the same as in Attanasio et al. (2018) and Hyslop (2001) (the latter reference is based on US data, but we follow the reasoning in Pizzinelli (2018) to argue that the value can be applied to UK data). To initialize the process, we also follow Pizzinelli (2018), who picks a value of 0.2, which he bases on Lise and Seitz (2011) their estimate of the intra-household correlation of income in the UK in the year 2000. The unemployment benefit is set to $b_u = 0.3$, the retirement income is given by a replacement rate of 50 % times the last income the individual earned during the working phase of the lifecycle.

5 Results

5.1 Parameter estimates

The parameter estimates are presented in table 4. We obtain an initial Pareto weight, which we can interpret as the initial (relative) bargaining power of a husband in the household is given by 0.7, which is the same as in Voena (2015). Turning to our estimates of the monetary costs of female labor force participation, $\delta^m(t)$ and $\delta^s(t)$, it is useful to contrast our estimates to those found in Pizzinelli (2018). In particular, we find larger (monetary) penalties for labor force participation of women, especially married women, whereas Pizzinelli's estimates are close to our estimates for monetary costs of labor force participation for single women. Interestingly, we also find that the preference parameters for housing are larger for women than men, indicating that, on the basis of our estimates, women obtain more utility from home ownership and housing size. This is in line with the suggestion made in Lafortune and Low (2020), that housing can act as a collateral for commitment within a household. This uncovered heterogeneity in preferences for housing again shows the relevance of our limited commitment collective framework, in particular to conduct proper welfare analysis.

5.2 Model fit and summary statistics

A comparison between the targeted moments in the data and those obtained from our estimated model are provided in table 5. Overall, we fit the moments quite well. This implies that average outcomes in terms of the key household decisions such as (female) labor supply and housing demand are captured well by our structural model. We slightly overestimate the effects on the crude divorce rate in response to the *White v. White* reform. The latter might be suggestive for the fact that the implied distribution of net wealth post-divorce in expression (32) suggests a much more inegalitarian division than the effective inequity between spouses under the pre-*White v. White* (discretionary) regime. Furthermore, the much stronger response of the reform on the (crude) divorce rate then also translates in a (slightly) lower estimate of the labor supply response.

We now turn to some further descriptive statistics from the simulations, which are crucial to understand further the household's response to (income) shocks. In particular, table 6 presents the average working hours, earnings and wages for married individuals, broken up by housing tenure and by 10-year age groups. Married women in households owning a house work more hours than women in renter-households, both in our model and in the data. This is obviously related to the idea that the secondary earner's labor supply acts as an insurance device against income and wealth shocks and is in line with earlier findings by Bottazzi et al. (2007) and Pizzinelli (2018). We also find, across the lifecycle, that (overall) private consumption is higher for homeowners than for renters. In the context of our model this is related to two specific features: first, homeownership relaxes the borrowing constraint and allows households to accumulate debt, in proportion to their income (LTI) and the housing value (LTV). In contrast, renters cannot hold debt given a lack of collateral. As a consequence, renter-households face tighter borrowing constraints. Second, homeownership raises the expected wealth in the latter part of the lifecycle when the housing assets can be sold. The latter mechanism would be reinforced in the case where there is a positive trend in housing values (Sinai and Souleles, 2005; Aladangady, 2017).

As a next step, we can analyze the relationship between (married) female labor supply and (net) housing wealth, the latter being defined as the difference between the housing value and (outstanding) debt. First, the simulated net housing wealth is presented in figure 3. The summary statistics are contained in table 7. In the table, we look at average (married) female working hours, male earnings and female wages across the quartiles of the net housing wealth distribution, and by 10 year age groups for the first part of the lifecycle.[26] A first observation is that the overall labor supply and earnings/wage patterns across net wealth are relatively well aligned between model and data. Second, we note that higher net housing wealth is negatively correlated with female labor supply. These findings are in line with empirical findings in Henley (2004), Milosch (2014) and Disney and Gathergood (2018), who find negative wealth effects on female labor supply, where higher wealth is used to substitute market hours by increased childcare and/or home production. Another observation is the positive gradient for both average men's earnings and women's wages across the net housing wealth distribution. Finally, private consumption levels are higher for households in higher quartiles of the distribution of net housing wealth. There are several possible channels for this relationship: first, there is a possible wealth effect: larger net housing wealth means more resources which can be used for

[26]We focus on the early part of the lifecycle between 30 and 50, given the absence of a realistic retirement dynamic in the model. We leave such an important extension as an avenue for future research.

increased consumption. Second, higher net housing wealth helps in alleviating leverage-based constraints, in particular the LTV-limit, which implies the household can have a larger degree of leverage and therefore higher consumption. Ultimately, the question as to what drives the relationship between consumption and housing wealth (or more broadly housing prices) is empirical and has been studied (among others) by Ortalo-Magné and Rady (2006), Campbell and Cocco (2007), Attanasio et al. (2011), Aladangady (2017) and Etheridge (2019).

6 Policy experiments

One of the beneficial features of our paper is that, by adding realistic features such as limited commitment and (endogenous) divorce decisions, we can add to the literature on household finance in terms of how leverage constraints affect household outcomes. To be more specific, we will study how changes in the leverage-based (i.e., LTV and LTI) limits on debt accumulation affect housing demand and labor supply of households. Note that, in addition to the traditional mechanisms of such debt limits on home ownership or labor supply, as studied by both Bottazzi et al. (2007) and Pizzinelli (2018), easing or tightening access to credit equally has the potential to affect the relative value of marriage. Indeed, besides economies of scale in consumption, as exemplified in (3), there are additional benefits for married people in terms of loosening their debt constraints relative to singlehood. This becomes clear by comparing (15) and (18)-(19). In this section, we will conduct several policy experiments by changing the value of the credit market-related parameters in our models, which determine the relative ease at which households can access credit given their earnings or given the housing value.

6.1 Tightening the LTI constraint

The first policy experiment pertains to a tightening of the income-related debt constraint. We recall that the LTI-limit for borrowing stipulates that a household cannot accumulate more debt than a weighted some of both spouse's earnings, that is, $\lambda_y y_t^M + \lambda_y^F w^F n_t^F$. In the baseline version of the model we have picked (common) values of $\lambda_y = 3$ and $\lambda_y^F = 1$. This implies that the secondary earner's labor income gets weighted by one third of the primary earner's earnings. This is to reflect a level of risk assessments by credit lenders, discounting the more variable secondary earner's earnings. We now consider the counterfactual scenario where access to credit is made more difficult for households. In particular, we will consider a lowering of the income-multiplier pertaining to the secondary earner, that is, we decrease λ_y^F, which we calibrate so as to obtain a decrease in the homeownership rate of about 10 p.p. for couples at age 35.[27]

First note that with such a reform, particularly households with relatively lower primary earner's income levels will be facing a tighter borrowing constraint, which forces them to deleverage. The results of this tightening of credit access based on income are given in tables 9 and 10. Female labor supply is reduced on the intensive margin for the age range of 36-40 year olds. There are several channels through which the tightening of the LTI-limit for households can affect labor supply. First, the tightening of access to credit given the household's income implies that the barrier to homeownership increases. As a consequence, there are now less financial incentives to work (or work more) to access more credit and buy a house (or buy a larger house.) More directly, the lowering of λ_y^F reduces the returns to hours worked by the secondary earner, thereby reducing incentives for working more hours. These mechanisms are well-understood, even in the context of a lifecycle model for unitary households (Pizzinelli, 2018; Bartscher, 2020). Note that the effect of the policy seems to have limited labor

[27] The specific value is $\lambda_y^F = 0.55$.

supply effects later in the lifecycle. In contrast to a unitary model of the household, however, there is an additional mechanism in our framework which affects the behavioral responses to the policy reform. In particular, within our model, the reduction in the homeownership rate also reduces the relative benefits of marriage. Indeed, with the tightening of the income-related limit, the additional earnings from the secondary earner don't provide any further benefits to obtain credit to buy a (larger) house. This is reflected in table 9, in particular in the increase in the (crude) divorce rates across age ranges, though the strongest effect on divorces can be found in the age range of 36-40 year olds, who are (by construction) those most affected by the policy change. In contrast to the loss in the (relative) value of marriage for the secondary earner, primary earners (especially in those households who are already close to the income-related debt limit, see their relative outside value deteriorate due to the higher barrier to credit for housing. As a consequence, and in correspondence with our assumption of limited commitment, such a tightening of the LTI-limit can trigger a renegotiation of the intra-household allocation of resources in favor of the secondary earner. This is exemplified by the increase in the Pareto weight for women, which increases across most age ranges, with a particularly stronger effect in the relevant age range of 36-40 years old.

This effect of the policy on intra-household bargaining power is also reflected in the responses of consumption. First, we note that the tightening of the income-related debt limit forces households above the new limit to deleverage, which implies a reduction inn household consumption, as evidenced by the third column in table 10. We also note that the increased barrier to home ownership induces additional saving by young couples (those in the age range of 30-35 years old), with an average reduction of household consumption expenditures of about 5 %. This overall reduction in consumption is however not shared equally by household members. In particular, we notice that the largest share in the reduction of household consumption stems from a reduction in the primary earner's consumption. This is again consistent with an increase in the secondary earner's bargaining power, which implies a redistribution of expenditures in favor to secondary earners.

To have a better look at the interactions between housing demand and female labor supply in response to this reform, we decompose the responses in key outcomes by differences in housing tenure at the age of 35 between baseline and counterfactual scenarios. The results are presented in table 11.

A first observation is that a large fraction of households (about 74%) preserve their housing tenure status from the baseline in the counterfactual scenario. In the group of households who are homeowners in both scenarios we find the lowest effects on divorce. This is in line with the fact that returns to female labor supply in terms of gaining easier access to credit are reduced, as well as the fact that now there is a larger financial barrier to invest in larger houses. Households who are renting have on average lower household income and consumption (see table 6), and might therefore lack in the means to compensate the secondary earner for the reduction in the (expected) value of marriage due to a higher barrier for homeownership. As a consequence, we see a slightly larger effect in terms of marital instability due to the tighter LTI-limit. Finally, the most interesting group are those households who are on the margin with regards to housing decisions. In particular, the 8 % of households who are now renters in the counterfactual scenario. These households were close to the LTI-limit in the baseline, which correlates with on average lower earnings for the primary earner. As a consequence, a tightening of the LTI-limit for these households implies that the outside value from marriage decreases (since the barrier for homeownership has increased), whereas for secondary earners in these marriages, the value of marriage has decreased. As a consequence, there are two possibilities: either the household has sufficient resources to compensate the secondary earner, making her indifferent between staying inside or leaving the marriage, or the household income is insufficient to redistribute resources and in that case the couple will break up. We present the average earnings for both husbands and wives by housing tenure ate age 35 in table 12.

6.2 Relaxing the LTI constraint

As a second exercise, we now consider a loosening in the income-related debt limit. In particular, we increase the weight on female earnings in the borrowing constraint pertaining to the LTI ratio, λ_y^F to a value of 3, which implies that women's earnings are no longer treated differently depending on marital status and that there is no discrimination between the primary or secondary earner's income in the borrowing constraint, (15). Such a policy reform can be motivated by a desire of treating individuals equally regardless of their gender and/or marital status and thereby addresses concerns of fairness.[28] Similar to the case of a tightening of the LTI-limit, we first present the responses to the policy change broken down by age. These are represented in tables 13 and 14. Theoretically, such a policy implies first that the returns to (married) women's labor supply increase. Second, the barrier to homeownership is lowered, which increases housing demand and consequently reinforces the financial incentives to increase the secondary earner's labor supply. These predictions are confirmed in table 13, with an increase in married women's labor supply, both on the extensive and intensive margins and across all age ranges. We note that the strongest increase in female labor supply can be found in the age range of 41-45 year olds, which is consistent with the feature that the female employment rate picks up in this age range. Similar to the case of a tightening of the LTI constraint, we have an addi-

[28]An example of such a reform is the so-called Equal Credit-Opportunity Act (ECOA) in 1974 in the US. The ECOA prohibited an unequal treatment of individuals based on their marital status and/or gender in their mortgage applications. This particular policy has been studied empirically in an event-study setting by Bartscher (2020), who has shown a positive effect on housing demand (homeownership rates) and female labor force participation.

tional channel at work in our model. In particular, the increase in λ_y^F implies an increase in the (relative) value of marriage for married women, thereby reducing marital instability. This is reflected in the reduction in the (crude) divorce rates across the different age ranges. However, the increase in housing wealth can also increase the outside value, due to higher residual wealth that can be divided upon divorce. The latter might have a particular effect for those households with larger primary LTI ratios (i.e., relatively low income levels of the primary earner), who have lower consumption levels, and consequently there is a trade-off between the (potentially) larger individual consumption levels post-divorce or accumulating more housing wealth in marriage. This trade-off is relevant for primary earners with lower income levels and a loosening of the LTI-limit might actually improve their outside value from marriage. This is also reflected in the lower (average) Pareto weight for the wife's utility.

The additional channel of intra-household bargaining can also be illustrated on the effects on individual-level consumption after the loosening. In particular, the wife's consumption decreases across all age ranges, and with the exception of the age range of 36-40 year olds, it decreases even more than the husband's consumption. We also note that the increase in the (married) women's employment rate is the largest for the age range of 36-40 year old, which can explain why the wife's consumption does not decrease by more than the husband's in that age range.

The breakdown by housing tenure is given in table 15. The strongest response in female labor supply (hours worked) can be found in the group of households who have become homeowners in the counterfactual scenario, which can be easily explained by the fact these households now require additional income to satisfy the borrowing constraint and accumulate housing wealth. The reduction in marital instability is also the most pronounced in this group, given that for these households the marital surplus has increased through acquiring housing wealth.

6.3 Tightening the LTV constraint

We now turn to a policy simulation that tightens credit market access through a lowering of the LTV-limit. In practice, such a reform would imply an increase in the downpayment required to purchase a house. We simulate this reform by changing the parameter λ_H such that the homeownership rate drops by about 10 percentage points at the age of 35.[29] The results on (married) female labor supply, (crude) divorce rates and consumption are presented in tables 17 and 18. We first note the almost null effect on female labor supply in the age range of 36-40 year old individuals, which is consistent with the earlier findings in Pizzinelli (2018), and small reductions in labor supply, both on extensive and intensive margin, for women aged 41 and older. Similar to the case of the LTI tightening, a decrease in the LTV limit imposes a higher barrier for housing demand. As a consequence, the value of marriage stemming from the possibility to have an easier access to housing wealth through income pooling is depreciated and consequently, marital stability deteriorates. The latter is reflected in the increase in the (crude) divorce rate across the different age categories.

The reduction in housing wealth (either in the sense of buying a smaller house/flat or becoming renters in the counterfactual scenario) clearly affects both spouses, however, given the higher than average potential wages and the lower private consumption of the secondary earner, the latter's outside value is now more likely to be attractive. Indeed, by divorcing they can recuperate a part of the housing wealth, while their larger potential wages offer them outside options to buy a house with their own resources. Given the limited commitment present in the model, this would suggest that the husband has to compensate the wife either through increased consumption or an increase in leisure. This intra-household

[29] The particular new parameter value $\lambda_H = 0.776$.

reallocation of resources is reflected in the increase in the (average) wife's Pareto weight, across all age ranges. Similarly, as table 18 shows, the wife's consumption increases compared to the old scenario under the original LTV limit.

We have also again broken down the main household responses by housing tenure at age 35, which is presented in table 19. We find that across all groups there is a (small) reduction in hours worked by the secondary earner. Interestingly, the strongest reduction is found among those households who still own a house under both the old and counterfactual LTV-limit. This is due to the reduction in housing wealth (buying a smaller house or flat) and the intra-household redistribution of resources, which implies an increase in the wife's leisure time. Clearly, the downsizing of housing demand under the counterfactual scenario also allows the household to increase overall consumption in this group, which is reflected in the overall increase in household consumption with the new LTV-limit.

The largest effect on marital instability can again be found in the group of households that have now become renters in the counterfactual scenario. These households are generally characterized by lower household income than the group who still own a house and therefore have generally lower marital surplus to be redistributed in order to keep both spouses willing to stay inside the marriage.

6.3.1 Contemporaneous labor supply effects

For completeness, we also report the contemporaneous response in terms of the secondary earner's labor supply to the different policy changes, again broken down by housing tenure at age 35. The results are presented in table 21. An interesting finding is the fact that a tightening in the debt-to-income (LTI) or the LTV generates an opposite effect in terms of (married) women's labor supply, for those households who still own a house in both the baseline as the counterfactual scenarios. This finding is consistent with empirical findings in the literature that suggest a change in the LTV-limit generates a (contemporaneous) response in (female) labor supply opposite to the direction of the change in the LTV limit (Boca and Lusardi, 2003; Bui and Ume, 2020; Bartscher, 2020). In particular, a loosening of the LTV limit has been found to negatively affect the secondary earner's labor supply, which can be explained through a simple substitution channel between debt and female labor supply within the household.

6.4 Welfare analysis of credit policies

We have so far considered the household's responses in terms of the secondary earner's labor supply, household and individual consumption and marital instability. We now turn to a welfare-based analysis of the credit-market policies we have studied in this section.To be more precise, we use the Hicksian equivalent variation (HEV) as a measure to compute how a policy change impacts an individual's welfare. Intuitively, the HEV measures the proportionate amount by which individual consumption and leisure have to change in order to make an individual indifferent (in terms of expected lifetime utility) between the baseline economy (under the baseline LTV and LTI limits) and the counterfactual scenario with an altered LTV or LTI limit.[30] The interpretation of a positive value for the HEV is then that the individual gains from the particular policy, whereas a negative value reflects a welfare loss on the part of the individual from the specific policy. We refer to the Appendix, C.3 for the full computational details.

We report the average welfare effects (HEV) in table 22. The two policies which make credit access more difficult (either through a tightening of the LTI or LTV limit) generate welfare losses for almost all individuals. Clearly, this is a consequence of the fact that some individuals lose welfare due to the fact they are

[30]This manner of measuring welfare is slightly different from the often used consumption equivalent variation. However, we believe that the HEV is more robust to bias in the measurement of the wife's leisure (in particular due to a lack of household production in our model), by combining both consumption and leisure in the equivalent variation. Also note that for husbands the HEV coincides with the traditional consumption equivalent variation.

now renting their flat/house instead of having ownership over their housing, the latter providing a positive source of welfare. Alternatively, in the counterfactual scenario of more difficult access to credit some households are now living in a smaller house/flat and have seen a reduction of the accumulated housing wealth. Furthermore, the tightened borrowing constraints can also induce a reduction in household consumption in the counterfactual compared to the baseline economy.

An interesting finding is that women who are living in households that own a house in both the baseline as the counterfactual economy with tightened LTV limit do not incur any welfare loss. This is the result of the intra-household redistribution of resources in that group of households (see table 19.)

We also note the heterogeneity in welfare losses by the specific mode of tightening in the credit market. In particular, the welfare losses from a tightening in the LTI-limit is larger than those incurred through a tightening in the LTV-limit. This is mostly the result from the persistence in the drop in the homeownership rate and the margin of adjustment: under the LTV-tightening, there are more households who still buy a flat/house, but a smaller one compared from in the baseline economy.

6.5 Effects of commitment and divorce

Our model enriches the standard unitary lifecycle model by incorporating dynamics in the intra-household allocation of resources, as well as for (endogenous) divorce risk. To further study the importance of these channels, we conducted an additional counterfactual exercise in which we shut down the possibility of divorce and fix the Pareto weights at their average level in the simulations, which corresponds to a so-called full commitment scenario.[31] We solve the model twice per each policy exercise. In each case we use the estimated parameters, but

[31] A dynamic collective household model with full commitment is essentially equivalent to a standard unitary model. (Mazzocco, 2007; Adams et al., 2014; Chiappori and Mazzocco, 2017).

exclude the possibility for divorce and use the fixed Pareto weights. The first case is with the baseline policy parameters ($\lambda_y^F = 1$ and $\lambda_H = 0.9$) and the second case is with the altered policy parameter values, in the same way as we computed the effects of the policy experiment under limited commitment within the household. We then compute the Hicksian equivalent variation for the policy simulations. The results are also presented in table 22, columns 3-4.

We do observe quite some differences in the HEV-based welfare measure, comparing limited commitment with full commitment. Most prominently, we find that for men, the welfare gains of a loosening the debt servicing limit are underestimated by ignoring the limited commitment and divorce channels. In particular, the loosening of the LTI-limit decreases the dependence of husbands with lower earnings and consequently higher primary LTI ratios. In particular, the increase in housing wealth improves welfare directly, but can also improve the outside value as a risk insurance against divorce. The latter mechanism seems to play a larger role for those primary earners with lower income, which amplifies the implied welfare gains. In particular, we found evidence of renegotiations between spouses which shifted the intra-household allocation more in favor of the primary earner. Second, the welfare losses for the primary earner are much lower by ignoring the limited commitment channel. This is due to the fact that, in addition to the loss in housing wealth (due to the drop in homeownership rates),the tightening of the LTI-limit makes the secondary earner's outside option more attractive, thereby triggering a renegotiation in the intra-household allocation of resources in favor of the secondary earner. This thereby amplifies the welfare losses incurred by the husband, whereas it dampens the welfare losses for the secondary earner in those households who preserve their housing tenure from the baseline economy. In a similar fashion, the implied welfare outcomes stemming from a tightening in the LTV-limit are quantitatively quite different due to ignoring the divorce and limited commitment channels. In particular, the estimated welfare losses incurred by (married) women are much lower than the implied losses under full commitment, conversely for primary earners, whose welfare losses (for both homeowners and new renters) are exacerbated through limited commitment. This is again due to the fact that the secondary earner's outside value is positively affected by the increased barrier to credit market access, thereby either triggering a renegotiation of resources in her favor, or a divorce if total household resources are insufficient to make her just indifferent between staying inside or leaving the marriage.

7 Model's implications for behavior

We can also exploit the richness of our model, in particular the presence of leverage-based borrowing constraints and limited commitment within households, to study how households respond to different type of shocks. In particular, we will consider the household's responses to a (permanent) shock in the primary earner's income, a (permanent) shock to the secondary earner's (potential) wages and a persistent transitory shock to house prices.

7.1 Responses to income and wage shocks

The first exercise is a permanent, one standard deviation drop in the husband's earnings at different ages (in particular at ages 35, 45 and 55.) Such a permanent drop in (expected) household income from the time the shock occurs has several implications. First, the primary LTI ratio increases, ceteris paribus, which makes it more likely that the LTI-limit in the borrowing constraint, (15) becomes binding, which can be addressed either by a decrease in expenditures, an increase in the secondary earner's labor supply or a deleveraging in the household's balance sheet. Secondly, the loss in expected household income can trigger a decrease in the value of marriage, either directly (through reduced expected household income), but also indirectly through an effect in terms of lower housing wealth. Similar to our analysis of making access to credit more difficult (through a tightening in the LTI or LTV limit), such a reduced marital surplus can either lead to more marital instability (potentially divorce) or a renegotiation of the intra-household allocation of resources in favor of the secondary earner.

The responses in terms of the wife's hours worked, homeownership rate and household consumption are plotted in figure 4. Panel (a) shows the responses in hours worked by the secondary earner in the household and captures the so-called added worker effect. There is a small yet clear effect on the intensive margin of labor supply, with the response dampened when the shock occurs later in the lifecycle. Panel (c) illustrates the responses on household consumption, which drops in response to the shock, and the size of the drop is larger when the shock to the primary earner's income occurs later in the lifecycle. The latter shows how later in the lifecycle the added worker effect becomes less pronounced, which reflects itself in more volatile household consumption. Panel (b) shows how homeownership rates change in response to such a permanent drop in the primary earner's income. We see an equal and permanent drop in homeownership rates of about 4 to 6 percentage points.

We also consider the household's (average) short-run responses to a permanent fall in the primary earner's income, broken down by housing tenure and age at which the shock occurs. These are collected in table 23. Short-run is here defined as the immediate response, one year after the shock occurs. First, we note the presence of some added worker effects. Interestingly, we find strong effects among those households most on the margin of housing demand, in particular couples who were homeowners in the baseline economy, whereas they are renters in the counterfactual economy with a permanently lower primary earner's income level. This is plausible given the increased barrier to homeownership through the debt-to-income limit, which has become more binding in the counterfactual scenario. We notice in particular a strong effect on the extensive margin, where women now become active on the labor market to help alleviate the LTI-limit. Equally noteworthy is the uptick in the (crude) divorce rates and overall increase in marital instability, especially among those households who are renters in the counterfactual scenario. Given the (negative) relationship between homeownership and household income, this clearly suggests that divorce is directly related to adverse shocks in overall household resources, the latter reducing the material benefits of marriage. Finally, we note the effects on household consumption. A reduction in the primary earner's permanent income clearly has a negative impact on household spending, particularly among homeowners. This can be explained by the relatively higher commitments in resource allocations to satisfy the borrowing constraint (i.e., to pay mortgages), which is absent for renters. Household consumption is also strongly affected in the group of households who are renting in the counterfactual scenario. This is again consistent with the fact that these households are now facing a higher barrier to become homeowners, which forces them to reduce spending and accumulate savings in order to be able to buy a house.

We also experimented with a permanent shock in the secondary earner's wages, again at different ages (in particular age 35, 45 and 55.) The unconditional responses in labor supply, homeownership rates and household consumption are presented in Figure 5. The first thing to notice is the drop in female labor supply, due to the reduced returns of working. Homeownership rates initially drop by about 3-4 percentage points, which is less than in the case of a permanent drop in the primary earner's income (Figure 4). Furthermore, a shock to the secondary earner's wage seems to have less persistent effects than a drop in the primary earner's income. This is plausible given the higher overall effect of the latter in the borrowing constraints, in particular the income-related debt constraint. Household consumption also decreases, but less persistently so than in case of a permanent shock to the husband's income. We also provide a breakdown of responses by housing tenure and age. In particular, table 24 presents the responses in terms of labor supply (both on intensive and extensive margins), marital instability and household consumption. The first thing to note is that most of the responsiveness in housing demand (in terms of buying versus renting) occurs when the shock occurs at the age of 35, which is consistent with the pattern in Figure 5. Similar sized shocks occurring at age 45 and 55 do not have a strong response in homeownership status. The reduction in labor supply is smaller in households who are homeowners in both the baseline and counterfactual scenario. This is due to the fact that homeowners are tied to the leverage-based borrowing constraints. In particular the LTI-limit serves as an additional channel through which the secondary earner's labor supply provides returns for the household. Still focusing on labor supply, the effects are smaller when the shock occurs at age 45, especially on the intensive margin.

7.2 A persistent shock in house prices

Similar to Pizzinelli (2018), we have so far assumed that house prices are constant. This essentially removes (exogenous) wealth volatility and any variation in the ability of households to use housing assets as collateral. Such an assumption is tenable in an environment with moderately stable prices. However, given the prevalence of debates regarding the affordability of housing for younger couples, and subsequent delays in household formation (Berrington et al., 2021), it might be interesting to use our framework to study the impacts of shocks in house prices on household behavior. To be more precise, we assume an increase in house prices of 10 %, after which the prices revert back to their old levels through an autoregressive AR(1) process, with a coefficient equal to 0.94. This coefficient was computed by Attanasio et al. (2012) from the detrended and deflated UKHPI series.

Note that an increase in house prices can have several effects on households, in particular depending on when the shock occurs in the lifecycle, as well as on the housing tenure. In particular, an increase in house prices has a positive wealth effect on homeowners (as evident from the budget constraint, (14).) This can increase household consumption and/or decrease the wife's labor supply. In addition, the exogenous increase in housing wealth decreases the LTV-ratio, which has similar effects to easing the access to credit. However, an increase in house prices also increases the barrier to buy a (new) home, which can adversely affect (younger) households who will need to increase savings and rely more heavily on (costly) secondary earner's labor supply in order to be able to afford the higher downpayments.

We now turn to the results from the exercise considering an increase in house prices. The household responses in terms of the secondary earner's labor supply, marital instability and household consumption are presented in Table 25. We show these responses split by housing tenure and by the time in the lifecycle when the shock is supposed to occur. A first finding is that for those households who are homeowners in both the baseline and the counterfactual scenario of increased house prices the timing of the shock matters. In particular, when the shock occurs at age 30 there is a clear increase in the secondary earner's labor supply (both on the intensive as on the extensive margin). This is indicative for the fact that these households are still saving in order to be able to purchase a larger flat/house. In addition to this positive response in female labor supply, we also note the drop in overall household consumption. This is again suggestive for the fact that the (exogenous) housing wealth effect is dominated by the fact that households want to accumulate larger housing wealth endogenously. Note that, in case the shock occurs a bit later, i.e., at age 35, there is almost no effect on labor supply and a very small positive effect on household consumption. This implies that the wealth effect will become more dominant when unexpected price increases occur later in the lifecycle. This sort of heterogeneous effect depending on age of the household is also consistent with the empirical findings in Campbell and Cocco (2007).

There is also an increase in the secondary earner's labor supply in the group of new renters. This group consist of those households who were homeowners in the baseline scenario but now could no longer afford buying a house. Given this increased barrier to buy a house, households respond by relying more on the secondary earner's labor supply and substantially decreasing their consumption. This pattern is similar both when the shock occurs at age 30 or 35. Marital instability (again measured by the crude divorce rate) increases the most in the group of new renters, given that these are the households on the margin of homeownership and who experience the strongest change in marital surplus due to the increase in house prices.

We finally compute the welfare effects of this persistent shock in house prices. In particular, we calculated the Hicksian equivalent variation (HEV), which can be computed in a similar way as for the policy experiments in Section 6. More details can be found in the Appendix, C.3.

Table 26 presents the HEV broken down by housing tenure and by the age at which the shock occurs. Individuals living in households who remain homeowners under both the baseline and the counterfactual scenario incur welfare losses when the shock occurs earlier in the lifecycle, at the age of 30. When the shock occurs a bit later, at age 35, (married) women only incur a very small welfare loss, whereas (married) men actually even gain due to the exogenous increase in housing wealth. Perhaps unsurprisingly given our findings on the household responses in Table 25, we find that the strongest welfare losses are incurred by both men and women living in households who are on the margin of homeownership.

8 Conclusions

In this paper, we presented a limited commitment model of the household in which households make labor supply and housing demand decisions over the lifecycle. We exploited a policy change in post-divorce asset division in England to help identify and estimate our structural model. We have shown that credit market policies, in particular those pertaining to the leverage (p-LTI and LTV) ratios affect the relative value of marriage, which has important consequences for the (welfare) evaluations of credit market loosening or tightening. In addition, the presence of limited commitment is shown to be important to understand the responses of households to shocks in housing wealth and the primary earner's income.

References

Adams, A., L. Cherchye, B. D. Rock, and E. Verriest (2014). Consume now or later? time inconsistency, collective choice and revealed preference. *American Economic Review 104*, 4147–4183.

Aladangady, A. (2017). Housing wealth and consumption: evidence from geographically linked microdata. *American Economic Review 107*(11), 3415–3446.

Attanasio, O., R. Bottazzi, H. Low, L. Nesheim, and M. Wakefield (2012). Modeling the demand for housing over the life cycle. *Review of Economic Dynamics 15*(1), 1–18.

Attanasio, O., A. Leicester, and M. Wakefield (2011). Do house prices drive consumption growth? the coincident cycles of house prices and consumption in the uk. *Journal of the European Economic Association 9*(3), 399–435.

Attanasio, O., P. Levell, H. Low, and V. Sánchez-Marcos (2018). Aggregatig elasticities: Intensive and extensive margins of female labor supply. *Econometrica 86*, 2049–2082.

Attanasio, O., H. Low, and V. Sánchez-Marcos (2008). Explaining changes in female labor supply in a life-cycle model. *American Economic Review 98*(4), 1517–1552.

Bartscher, A. K. (2020). It takes two to borrow: the effects of the equal credit opportunity act on homeownership and mortgage debt of married couples. Technical report.

Bayot, D. and A. Voena (2015). Prenuptial contracts, labor supply and household investments. Technical report.

Berrington, A., V. Tocchioni, D. Vignoli, and A. Vitali (2021). Homeownership and the transition to parenthood. Technical report.

Blundell, R., M. Costa-Dias, C. Meghir, and J. Shaw (2016). Female labor supply, human capital and welfare reform. *Econometrica 84*, 1705–1753.

Blundell, R., L. Pistaferri, and I. Preston (2008). Consumption inequality and partial insurance. *American Economic Review 98*, 1887–1921.

Blundell, R., L. Pistaferri, and I. Saporta-Eksten (2016). Consumption inequality and family labor supply. *American Economic Review 106*(2), 387–435.

Boca, D. D. and A. Lusardi (2003). Credit market constraints and labor market decisions. *Labour Economics 10*(6), 681–703.

Borella, M., M. D. Nardi, and F. Yang (2018). The aggregate implications of gender and marriage. *Journal of the Economics of Ageing 11*, 6–26.

Bottazzi, R., H. Low, and M. Wakefield (2007). Why do home owners work longer hours? Technical report.

Browning, M., P.-A. Chiappori, and Y. Weiss (2014). The gains from marriage. In M. Browning, P.-A. Chiappori, and Y. Weiss (Eds.), *Economics of the Family*, Chapter 2.

Bui, K. D. and E. S. Ume (2020). Credit constraints and labor supply: Evidence from bank branching deregulation. *Economic Inquiry 58*(1), 335–360.

Campbell, J. Y. and J. F. Cocco (2007). How do house prices affect consumption? evidence from micro data. *Journal of Monetary Economics 54*(3), 591–621.

Chang, M. (2020). A house without a ring: the role of changing marital transitions in housing decisions. Technical report.

Chiappori, P. A. (1988). Rational household labor supply. *Econometrica 56*, 63–89.

Chiappori, P. A. (1992). Collective labor supply and welfare. *Journal of Political Economy 100*, 437–467.

Chiappori, P.-A., M. Costa-Dias, S. Crossman, and C. Meghir (2020). Changes in assortative matching and inequality in income: Evidence for the uk. Technical report.

Chiappori, P.-A., B. Fortin, and G. Lacroix (2002). Marriage market, divorce legislation and household labor supply. *Journal of Political Economy 110*, 37–72.

Chiappori, P. A. and M. Mazzocco (2017). Static and intertemporal household decisions. *Journal of Economic Literature 55*(3), 985–1045.

Choi, S. and A. Valladares-Esteban (2020). On households and unemployment insurance. *Quantitative Economics 11*, 437–469.

Disney, R. and J. Gathergood (2018). House prices, wealth effects and labour supply. *Economica 85*(339), 449–478.

Druedahl, J. (2015). The demand for housing over the life-cycle under long-term gross debt contracts. Technical report.

Eika, L., M. Mogstad, and B. Zafar (2019). Educational assortative mating and household income inequality. *Journal of Political Economy 127*, 2795–2835.

Etheridge, B. (2019). House prices and consumption inequality. *International Economic Review 60*(4), 1781–1822.

Fernández, R. and R. Rogerson (2001). Sorting and long-run inequality. *The Quarterly Journal of Economics 116*, 1305–1341.

Friedberg, L. (1998). Did unilateral divorce raise divorce rates? evidence from panel data. *American Economic Review 88*, 608–627.

Heathcote, J., K. Storesletten, and G. L. Violante (2014). Consumption and labor supply with partial insurance: an analytical framework. *American Economic Review 104*(7), 2075–2126.

Henley, A. (2004). House price shocks, windfall gains and hours of work: British evidence. *Oxford Bulletin of Economics and Statistics 66*.

Hyslop, D. R. (2001). Rising us eanings inequality and family labor supply: the covariance structure of intrafamily earnings. *American Economic Review 91*, 755–777.

Kapan, T. (2008). Property division laws: The effects on labour supply and household bargaining. Technical report.

Kaplan, G., B. Moll, and G. L. Violante (2018). Monetary policy according to hank. *American Economic Review 108*, 697–743.

Kaplan, G. and G. L. Violante (2014). A model of the consumption response to fiscal stimulus payments. *Econometrica 82*, 1199–1239.

Kaplan, G., G. L. Violante, and J. Weidner (2014). The wealthy hand-to-mouth. *Brookings Papers*, 77–138.

Lafortune, J. and C. Low (2020). Collateralized marriage. Technical report.

Ligon, E., J. P. Thomas, and T. Worrall (2000). Mutual insurance, individual savings, and limited commitment. *Review of Economic Dynamics 3*(2), 216–246.

Ligon, E., J. P. Thomas, and T. Worrall (2002). Informal insurance arrangements with limited commitment: Theory and evidence from village economies. *The Review of Economic Studies 69*(1), 209–244.

Lise, J. and S. Seitz (2011). Consumption inequality and intra-household allocations. *The Review of Economic Studies 78*, 328–355.

Low, H., C. Meghir, L. Pistaferri, and A. Voena (2018). Technical report, NBER.

Lundberg, S. (1985). The added worker effect. *Journal of Labor Economics 3*(1), 11–37.

Marcet, A. and R. Marimon (2019). Recursive contracts. *Econometrica 87*(5), 1589–1631.

Mazzocco, M. (2007). Household intertemporal behavior: A collective characterization and a test of commitment. *The Review of Economic Studies 74*(3), 857–895.

Mazzocco, M., C. Ruiz, and S. Yamaguchi (2014). Labor supply and household dynamics. *American Economic Review 104*, 354–59.

Meghir, C. and L. Pistaferri (2004). Income variance dynamics and heterogeneity. *Econometrica 72*, 1–32.

Milosch, J. (2014). House price shocks and labor supply choices. Technical report.

Newman, A. and C. Olivetti (2015). Career women and the durability of marriage. Technical report.

Ohinata, A. and M. Picchio (2020). Financial support for long-term elderly care and household saving behaviour. *Oxford Economic Papers 72*, 247–268.

Ortalo-Magné, F. and S. Rady (2006). Housing market dynamics: on the contribution of income shocks and credit constraints. *Review of Economic Studies 73*.

Piazzalunga, D. (2017). Till money do us part: Property division at divorce and married couples' time use behaviour. Technical report.

Pizzinelli, C. (2018). Housing, borrowing constraints, and labor supply over the lifecycle. Technical report.

Sinai, T. and N. S. Souleles (2005). Owner-occupied housing as a hedge against rent risk. *Quarterly Journal of Economics 120*(2), 763–789.

Smith, I. (2003). The law and economics of marriage contracts. *Journal of Economic Surveys 17*, 201–226.

Stowe, M. (2009). The family law case of the decade: White v white. https://www.stowefamilylaw.co.uk/blog/2009/12/29/white-v-white/.

Voena, A. (2015). Yours, mine, and ours: Do divorce laws affect the intertemporal behavior of married couples? *American Economic Review 105*(8), 2295–2332.

Wu, C. and D. Krueger (2021). Consumption insurance against wage risk: Family labor supply and optimal progressive income taxation. *American Economic Journal: Macroeconomics 13*(1), 79–113.

Yang, F. (2009). Consumption over the life cycle: how different is housing? *Review of Economic Dynamics 12*, 423–43.

A Summary statistics

The table below describes the main sample which we use to estimate the DiD results of the *White v. White* reform.

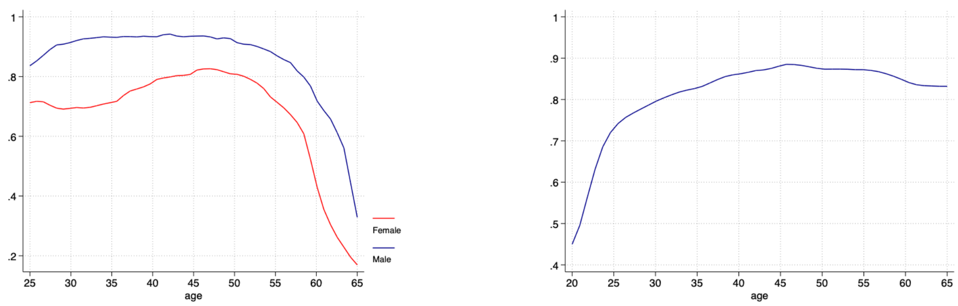
Table 1: Summary statistics of regression sample

Variable	Mean	St.deviation	number of obs.
Age	43.03	9.67	27,125
Higher educated	0.31	0.46	27,125
Wage	9.79	7.99	27,125
Nonlabor income	4,466.16	6,496.60	27,125
Earnings of spouse	21,291.83	16,092.28	27,125

Notes: The regression sample consists of all married women in age range of 25-60 years old, sample range 1992-2005. Non-labor income and wage levels are deflated by the CPI with 2014 as reference year. Higher educated refers to having at least obtained A-levels.

The lifecycle profiles of homeownership and employment rates are presented in the following figures:

Figure 1: Employment and homeownership rates over lifecycle



(a) Employment rates

(b) Homeownership rates

B Tables and figures: *White v. White* main analysis

Table 2: *White v. White* and labor supply of married women.

	$Hours_{i,c,r,t}$	$Employment_{i,c,r,t}$
$Post \times Treated_{r,t}$	-2.448***	-0.0349
	(0.935)	(0.023)
Observations	27,125	27,125
R-squared	0.191	0.157
Demographic (incl. spouse) controls	✓	✓
Year	✓	✓
Region	✓	✓
local female unemployment rate	✓	✓

Notes: estimation on sample of married women in age range of 25-60 years old, sample range 1992-2005. Standard errors clustered at the individual level, *** p<0.01, ** p<0.05, * p<0.1. Demographic (incl. spouse) controls includes age and age squared of the respondent, the age and age squared of the husband, the education level of the respondent, the education level of the husband; both defined as their highest qualification received, number of young children ($\leq$ 15 age old) and the household's non-labor income. Non-labor income is deflated by the CPI with 2014 as reference year.

Figure 2: Divorce rates.

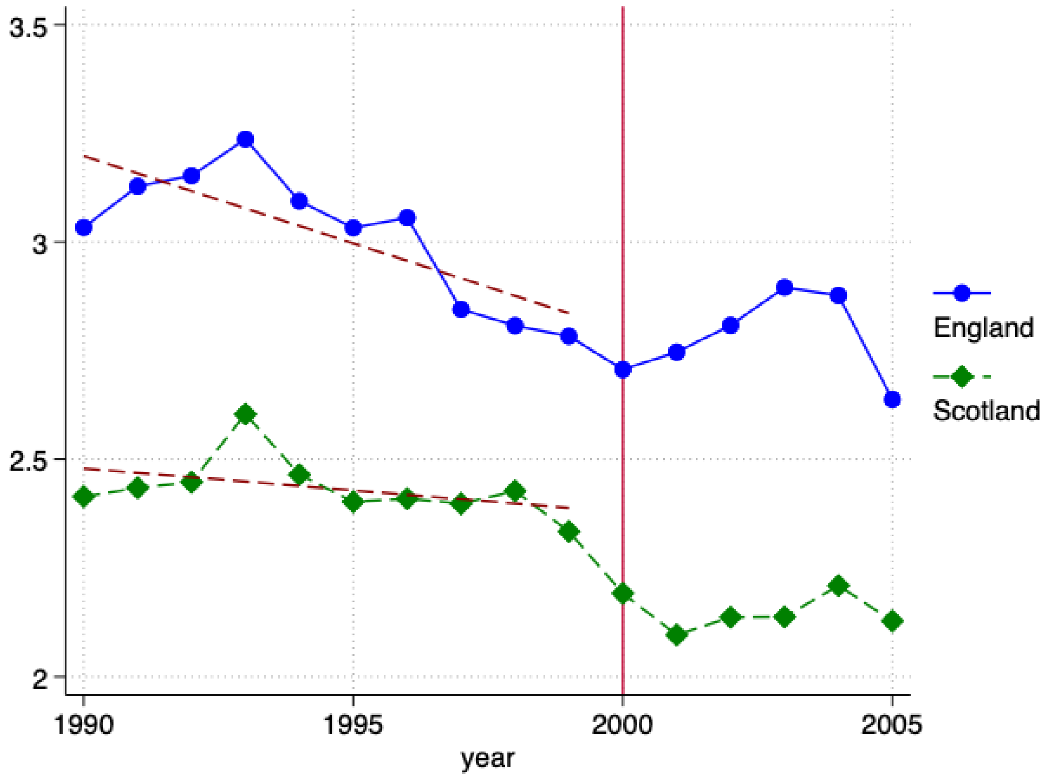


Table 3: *White v. White* and crude divorce rates.

	$Divorce_{c,t}$	$Divorce_{c,t}$
$Post \times Treated_{c,t}$	0.240**	0.210*
	(0.0857)	(0.102)
Observations	32	32
R-squared	0.986	0.986
Year	✓	✓
Country	✓	✓
Country $\times$ τ	✓	✓
Country $\times$ τ^2		✓

Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

C Results from the structural model

C.1 Estimates and fit

Table 4: Parameter estimates.

Parameter description		Estimate
Initial bargaining power (men)	$\tilde{\mu}_0$	0.7
Cost of work married women (linear term)	δ_1^m	0.0426
Cost of work married women (quadratic term)	δ_2^m	0.00093
Cost of work single women (linear term)	δ_1^s	0.029
Cost of work single women (quadratic term)	δ_2^s	0.00067
Preference for leisure married women	$\omega_n^{F,m}$	1.47274
Preference for leisure single women	$\omega_n^{F,s}$	0.7991
Preference for homeownership men	$\omega_{H,0}^M$	0.365
Preference for homeownership women	$\omega_{H,0}^F$	0.408
Preference for housing size men	$\omega_{H,1}^M$	0.815
Preference for housing size women	$\omega_{H,1}^F$	0.823
Variance match quality men	$\left(\sigma_\theta^M\right)^2$	0.000687
Variance match quality women	$\left(\sigma_\theta^F\right)^2$	0.00123

Table 5: Model simulations and data.

	Model	*Data*
White v. White response in hours worked	-0.018	-0.0244
Employment rate women 25-29	0.71	0.70
Employment rate women 30-34	0.70	0.698
Employment rate women 35-39	0.78	0.75
Employment rate women 40-44	0.80	0.80
Employment rate women 45-49	0.84	0.83
Average hours worked married women 25-29	0.2	0.232
Average hours worked married women 30-34	0.19	0.205
Average hours worked married women 35-39	0.193	0.199
Average hours worked married women 40 -44	0.24	0.219
Average hours worked married women 45 -49	0.239	0.232
Average hours worked single women 25-29	0.284	0.283
Average hours worked single women 30-34	0.25	0.25
Average hours worked single women 35-39	0.28	0.24
Average hours worked single women 40 -44	0.26	0.24
Average hours worked single women 45 -49	0.3	0.25
Homeownership rate married 30 - 50	0.87	0.86
Homeownership rate single women 30 - 50	0.55	0.55
Homeownership rate single men 30 - 50	0.65	0.68
Median housing value married 30 - 50	4.302	4.51
Median housing value singles 30 - 50	3.74	3.64
Crude divorce rate 30 - 50	0.002	0.003
The effect of *White v. White* on crude divorce rate 30 - 50	0.00066	0.00021

Table 6: Descriptive statistics by housing tenure

	Model		*Data*		*Model*		*Data*	
	30-39				40-49			
	Renters	*Homeowners*	*Renters*	*Homeowners*	*Renters*	*Homeowners*	*Renters*	*Homeowners*
Average hours worked	0.20	0.22	0.13	0.19	0.19	0.21	0.14	0.21
Average male earnings	0.61	1.14	0.61	1.26	0.53	1.57	0.50	1.21
Average female wages	0.87	1.05	0.77	1.08	1.37	1.22	0.75	1.02
Household private consumption	0.70	1.38	-	-	1.27	1.89	-	-
Private consumption (male)	0.46	1.04	-	-	0.77	1.42	-	-
Private consumption (female)	0.53	0.44	-	-	0.59	0.43	-	-

Notes: summary statistics for married individuals, split by housing tenure.

Figure 3: Distribution of net housing wealth

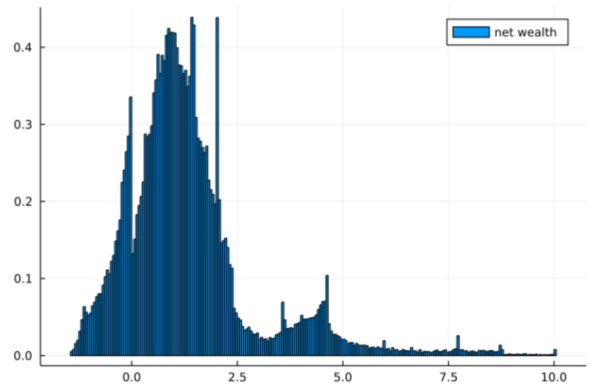


Table 7: Descriptive statistics by net housing wealth.

Quartiles	I	II	III	IV	I	II	III	IV
		Model				*Data*		
Age group 30 - 39								
Average hours worked	0.25	0.24	0.18	0.15	0.23	0.21	0.19	0.16
Average male earnings	0.85	1.09	1.16	1.40	1.09	1.17	1.25	1.44
Average female wages	1.10	0.99	0.95	1.07	1.00	0.98	1.06	1.29
Household private consumption	1.05	1.31	1.37	1.58	-	-	-	-
Private consumption (male)	0.75	1.00	1.02	1.14	-	-	-	-
Private consumption (female)	0.48	0.42	0.45	0.47	-	-	-	-
		Model				*Data*		
Age group 40 - 49								
Average hours worked	0.24	0.25	0.22	0.10	0.25	0.23	0.22	0.19
Average male earnings	1.40	1.37	1.12	2.29	1.02	1.06	1.15	1.39
Average female wages	1.26	1.1	1.21	1.44	0.90	0.95	0.95	1.17
Household private consumption	1.57	1.63	1.71	2.64	-	-	-	-
Private consumption (male)	1.16	1.26	1.30	1.89	-	-	-	-
Private consumption (female)	0.46	0.41	0.43	0.48	-	-	-	-

Notes: summary statistics for married individuals, split by net housing wealth.

Table 8: Simulations and data across leverage ratios

	LTV							
	Model		*Data*		*Model*		*Data*	
	30-39				40-49			
	Bottom 75%	Top 25%	Bottom 75%	Top 25%	Bottom 75%	Top 25%	Bottom 75%	Top 25%
Average hours worked	0.19	0.27	0.17	0.23	0.18	0.26	0.19	0.24
Average male earnings	0.842	1.16	1.10	1.23	1.17	1.58	1.18	1.22
Average female wages	0.83	1.24	1.01	1.09	1.09	1.21	0.99	1.06
Private consumption (male)	0.81	1.08	-	-	1.44	1.30	-	-
Private consumption (female)	0.466	0.445	-	-	0.461	0.422	-	-
	p-LTI							
	Model		*Data*		*Model*		*Data*	
	30-39				40-49			
	Bottom 75%	Top 25%	Bottom 75%	Top 25%	Bottom 75%	Top 25%	Bottom 75%	Top 25%
Average hours worked	0.197	0.30	0.17	0.23	0.19	0.278	0.19	0.25
Average male earnings	1.24	0.85	1.16	1.10	1.73	1.08	1.23	0.98
Average female wages	0.9	1.52	0.95	1.23	1.03	1.81	0.95	1.22
Female consumption (private)	0.44	0.45	-	-	0.44	0.42	-	-
Male consumption (private)	0.99	1.17	-	-	1.41	1.47	-	-

C.2 Policy simulations

Table 9: LTI tightening.

Age range	△ Pareto weight	△ divorce	△ employment rate	△ hours worked
36 - 40	0.0337	0.0337	0.0032	-0.0041
41 - 45	0.0036	0.0271	0.005	0.0004
46 -50	-0.00013	0.013	0.005	0.0005

Notes: Change in (married women's) hours worked, household consumption and the crude divorce rates in response to the tightened-LTI constraints. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 10: LTI tightening: consumption.

Age range	△ male private cons	△ female private cons	HH cons
36 - 40	-0.0208	0.0050	-0.0194
41 - 45	-0.0081	0.0015	0.0076
46 -50	-0.0002	0.0017	0.00092

Notes: Change in household, husbands' and wives' consumption. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 11: LTI tightening: breakdown by housing tenure.

	% of HH's	△ hours worked	△ divorce	△ HH private cons
Homeownwers in both cases	0.74	-0.0037	0.0062	0.0089
Renters in both cases	0.18	-0.0046	0.018	0.0035
New renters	0.08	0.0039	0.048	-0.024
Aggregate	1	-0.0043	0.073	-0.012

Notes: Change in (married women's) hours worked, household consumption and the crude divorce rates in response to the tightened-LTI constraints. The decomposition by housing tenure is made at age 35. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 12: LTI tightening: average earnings.

	35 -39		40 -49		50 -59	
	Male	Female	Male	Female	Male	Female
Homeownwers in both cases	1.15	0.76	1.38	0.70	1.59	0.60
Renters in both cases	0.62	0.43	0.72	0.48	0.80	0.46
New renters	0.67	0.57	0.83	0.65	0.95	0.58

Earnings breakdown at age 35 by housing tenure at age 35. For married women, earnings are computed as wages multiplied by hours worked. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 13: LTI loosening.

Age range	△ Pareto weight	△ divorce	△ employment rate	△ hours worked
36 - 40	-0.0432	-0.065	0.014	0.014
41 - 45	-0.0569	-0.08	0.041	0.018
46 -50	-0.0564	-0.13	0.019	0.020

Notes: Change in (married women's) hours worked, household consumption and the crude divorce rates in response to the relaxed LTI constraints. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 14: LTI loosening: consumption.

	LTI - relaxed		
Age range	△ male private cons	△ female private cons	HH cons
36 - 40	0.027	-0.0084	0.0337
41 - 45	-0.018	-.015	-0.0242
46 -50	-0.017	-0.021	-0.0251

Notes: Change in household, husbands' and wives' consumption. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 15: LTI loosening: breakdown by housing tenure.

	% of HH's	△ hours worked	△ divorce	△ HH private cons
Homeownwers in both cases	0.81	0.011	-0.009	0.007
Renters in both cases	0.07	0.01	-0.025	0.0005
New homeowners	0.12	0.026	-0.098	0.0052
Aggregate	1	0.048	-0.13	0.013

Notes: Change in (married women's) hours worked, household consumption and the crude divorce rates in response to the relaxed LTI constraints. The decomposition by housing tenure is made at age 35. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 16: LTI loosening: average earnings.

	35 -39		40 -49		50 -59	
	Male	Female	Male	Female	Male	Female
Homeownwers in both cases	1.09	0.75	1.31	0.70	1.52	0.59
Renters in both cases	0.64	0.16	0.74	0.30	0.82	0.30
New homeowners	0.615	0.57	0.71	0.60	0.79	0.56

Earnings breakdown at age 35 by housing tenure at age 35. For married women, earnings are computed as wages multiplied by hours worked. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 17: LTV tightening.

Age range	△ Pareto weight	△ divorce	△ employment rate	△ hours worked
36 - 40	0.044	0.0063	0.0084	0
41 - 45	0.039	0.0060	-.0138	-0.007
46 -50	0.023	0.00074	-0.0393	-0.018

Notes: Change in (married women's) hours worked, household consumption and the crude divorce rates in response to the tightened LTV constraints. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 18: LTV tightening: consumption.

Age range	△ male private cons	△ female private cons	HH cons
36 - 40	-0.029	0.014	-0.023
41 - 45	0.012	0.024	0.023
46 -50	0.0086	0.014	0.016

Notes: Change in household, husbands' and wives' consumption. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 19: LTV tightening: breakdown by housing tenure.

	% of HH's	△ hours worked	△ divorce	△ HH private cons
Homeownwers in both cases	0.71	-0.020	0.0002	0.035
Renters in both cases	0.166	-0.0063	0.020	0.01
New renters	0.10	-0.0067	0.037	-0.0038
Aggregate	1	-0.033	0.058	0.0434

Notes: Change in (married women's) hours worked, household consumption and the crude divorce rates in response to the tightened LTV constraints. The decomposition by housing tenure is made at age 35. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 20: LTV loosening: average earnings.

	35 -39		40 -49		50 -59	
Homeowners in both cases	1.15	0.79	1.38	0.73	1.59	0.62
Renters in both cases	0.60	0.45	0.70	0.49	0.78	0.47
New renters	0.83	0.40	0.98	0.50	1.10	0.43

Earnings breakdown at age 35 by housing tenure at age 35. For married women, earnings are computed as wages multiplied by hours worked. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

Table 21: Contemporaneous labor supply responses: policy changes.

	tightened LTI	LTI loosened	LTV tightened
Homeowners in both cases	-0.012	0.016	0.015
Renters in both cases	-0.021	-0.033	-0.018
New housing tenure	0.057	-0.015	0.061
Aggregate	0.024	-0.032	0.030

Notes: Contemporaneous change in (married women's) hours worked, for the different policy exercises. The decomposition by housing tenure is made at age 35. All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

C.3 Welfare analysis

We give an outline of how we compute welfare at the individual level. Fix a set of simulated paths for match quality, male earnings and female wages. Then, for a given household we can compute the resulting (simulated) paths for the outcome variables, $c_t^M, c_t^F, x_t, H_t, l_t^F$. With these we can compute, for each individual within each household their expected (lifetime) utility, as follows:

$$U^i = \sum_{t=1}^{T_d} \beta^{t-1} u^i \left(c_t^i, l_t^i, H_t, \theta_t \right).$$

Similarly, the expected lifetime utility can also be computed in the counterfactual case (e.g. for LTI-tightening, simulate new consumption, leisure and housing demand paths using the policy functions with the new λ_y^F value, but for same set of simulated paths of match quality, male earnings and female wages.) In particular, if we let $\tilde{c}_t^M, \tilde{c}_t^F, \tilde{x}_t, \tilde{H}_t, \tilde{l}_t^F$ denote the simulated paths for the choices under the counterfactual scenario, then:

$$\tilde{U}^i = \sum_{t=1}^{T_d} \beta^{t-1} u^i \left(\tilde{c}_t^i, \tilde{l}_t^i, \tilde{H}_t, \theta_t \right).$$

To evaluate welfare, we then find a value z such that:

$$\sum_{t=1}^{T_d} \beta^{t-1} u^i \left((1+z) c_t^i, (1+z) l_t^i, H_t, \theta_t \right) = \tilde{U}^i.$$

Then an average value for z can be computed for either subgroups (new renters, always homeowners, always renters) and for the aggregate economy.

Note: the same procedure can also be applied to do welfare analysis of income shocks. For example, say we want to analyze the welfare effects for i of a permanent income shock (either male earnings or female wages) at time τ, then in this case the "counterfactual" policies would simply be the post-shock outcomes and we can compute expected lifetime utilities in both scenarios like here above, with the only difference that the index starts at the time when the shock hits, that is:

$$U_\tau^i = \sum_{t=\tau}^{T_d} \beta^{t-\tau} u^i \left(c_t^i, l_t^i, H_t, \theta_t\right),$$

and

$$\tilde{U}_\tau^i = \sum_{t=\tau}^{T_d} \beta^{t-\tau} u^i \left(\tilde{c}_t^i, \tilde{l}_t^i, \tilde{H}_t, \theta_t\right).$$

And then the welfare measure (for individual i) would be the value of z such that:

$$\sum_{t=\tau}^{T_d} \beta^{t-\tau} u^i \left((1+z)c_t^i, (1+z)l_t^i, H_t, \theta_t\right) = \tilde{U}_\tau^i.$$

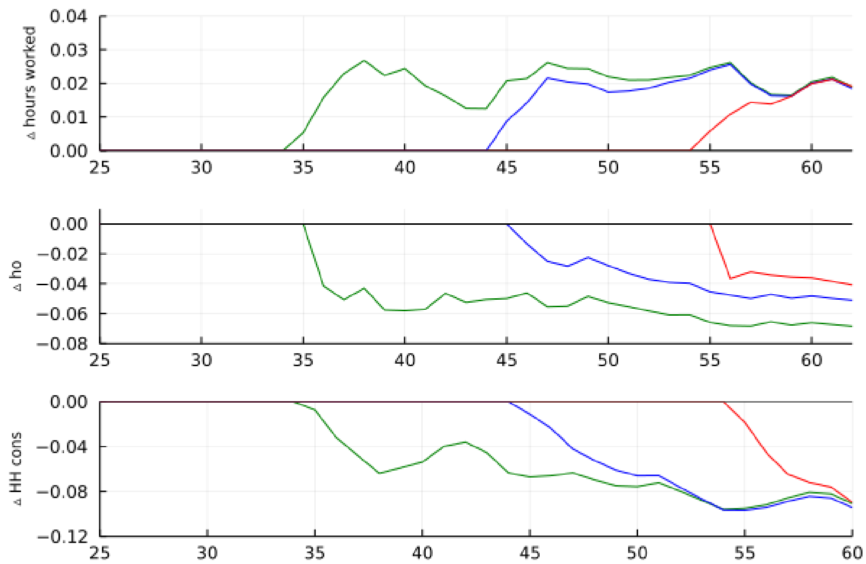
Table 22: Welfare analysis: credit market policies

	LTI - relaxed			
	Female (LC)	Male (LC)	Female (FC)	Male (FC)
Homeowners in both cases	0.0079	0.14	0.0068	0.029
Renters in both cases	0.013	0.025	0.0046	0.0099
New homeowners	0.021	0.39	0.058	0.089
	LTI - tightened			
	Female (LC)	Male (LC)	Female (FC)	Male (FC)
Homeowners in both cases	-0.0018	-0.049	-0.0087	-0.026
Renters in both cases	-0.0030	-0.023	-0.0023	-0.0027
New renters	-0.022	-0.15	-0.0044	-0.0060
	LTV - tightened			
	Female (LC)	Male (LC)	Female (FC)	Male (FC)
Homeowners in both cases	0.0065	-0.026	-0.2	-0.031
Renters in both cases	-0.0006	-0.037	-0.207	-0.0006
New renters	-0.016	-0.137	-0.16	-0.062

Average Hicksian equivalent variation across different policy simulations, by gender and for both limited and full commitment (Resp. LC and FC). All calculations performed using the same set of 10,000 simulations for earnings, wages and match quality.

C.4 Model's implications for behavior

Figure 4: Household responses: permanent shock husband's income



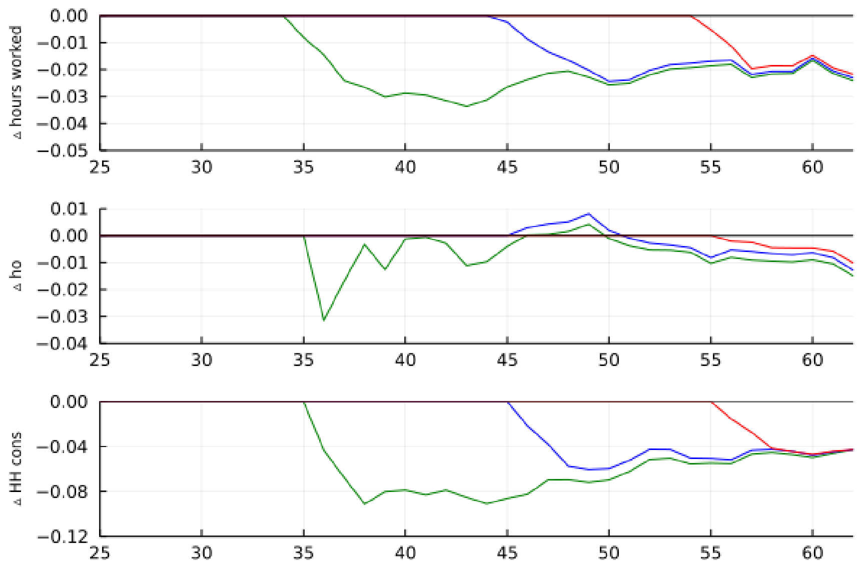
Panel (a) reports the response of the wife's labor supply, change in hours worked per week, compared to baseline. Panel (b): home ownership rate (percentage points). Panel (c) shows the change in household consumption (percentage points) to a permanent (unexpected) one-standard deviation fall in female wages occurring at ages 35, 45, and 55. All plots are produced with the same set of 10,000 individual simulations for earnings, wages and match quality.

Table 23: Permanent shock primary earner's income

	Age at shock 35				
	% HH	△ hours worked	△ employment rate	△ divorce (p.p. per 1000)	△ HH cons
Homeownwers in both cases	0.735	0.022	0.036	0.002	-0.069
Renters in both cases	0.241	0.027	0.091	0.08	-0.043
New renter	0.0557	0.1	0.35	0.087	-0.32
	Age at shock 45				
	% HH	△ hours worked	△ employment rate	△ divorce (p.p. per 1000)	△ HH cons
Homeownwers in both cases	0.92	0.015	0.047	-0.0005	-0.036
Renters in both cases	0.049	0.014	0.008	0.069	-0.018
New renter	0.020	0.030	0.050	0.11	-0.15
	Age at shock 55				
	% HH	△ hours worked	△ employment rate	△ divorce (p.p. per 1000)	△ HH cons
Homeownwers in both cases	0.923	0.010	0.047	0.002	-0.071
Renters in both cases	0.029	0.041	0.087	0.063	0.048
New renter	0.055	0.095	0.32	0.35	-0.35

Household responses in terms of secondary earner's labor supply (both intensive as extensive margin), (crude) divorce rate and household consumption (relative terms) to a permanent one standard deviation shock in the primary earner's income at different ages. All computations were done using the same set of 10,000 individual simulations for earnings, wages and match quality

Figure 5: Household responses: permanent shock wife's wage



Panel (a) reports the response of the wife's labor supply, change in hours worked per week, compared to baseline. Panel (b): home ownership rate (percentage points). Panel (c) shows the change in household consumption (percentage points) to a permanent (unexpected) one-standard deviation fall in female wages occurring at ages 35, 45, and 55. All plots are produced with the same set of 10,000 individual simulations for earnings, wages and match quality.

Table 24: Permanent shock secondary earner's wage

	Age at shock 35				
	% HH	△ hours worked	△ employment rate	△ divorce (p.p. per 1000)	△ HH cons
Homeownwers in both cases	0.723	-0.019	-0.068	0.0005	-0.10
Renters in both cases	0.232	-0.035	-0.14	0.023	-0.13
New renter	0.042	-0.034	-0.12	0.005	-0.15
	Age at shock 45				
	% HH	△ hours worked	△ employment rate	△ divorce (p.p. per 1000)	△ HH cons
Homeownwers in both cases	0.93	-0.007	-0.051	0.0003	-0.059
Renters in both cases	0.053	-0.004	-0.012	0.036	-0.11
New renter	0.002	0.027	0.15	0.011	-0.073
	Age at shock 55				
	% HH	△ hours worked	△ employment rate	△ divorce (p.p. per 1000)	△ HH cons
Homeownwers in both cases	0.96	-0.015	-0.043	0.0002	-0.043
Renters in both cases	0.026	-0.012	-0.027	0.036	-0.11
New renter	0.005	-0.036	-0.17	0.003	-0.06

Household responses in terms of secondary earner's labor supply (both intensive as extensive margin), (crude) divorce rate and household consumption (relative terms) to a permanent one standard deviation shock in the primary earner's income at different ages. All computations were done using the same set of 10,000 individual simulations for earnings, wages and match quality

Table 25: Persistent shock house prices

	Age at shock 30				
	% HH	△ hours worked	△ employment rate	△ divorce (p.p. per 1000)	△ HH cons
Homeownwers in both cases	0.54	0.017	0.050	0	-0.039
Renters in both cases	0.416	-0.002	-0.007	0.0002	-0.026
New renter	0.034	0.086	0.32	0.010	-0.39
	Age at shock 35				
	% HH	△ hours worked	△ employment rate	△ divorce (p.p. per 1000)	△ HH cons
Homeownwers in both cases	0.76	0.0007	0.0027	0	0.009
Renters in both cases	0.20	0.009	0.020	0.002	-0.021
New renter	0.030	0.068	0.23	0.042	-0.25

Responses to a persistent 10 % increase in housing prices in terms of hours worked, divorce rate (change is expressed in percentage points per 1,000 households), and household consumption. All computations were done using the same set of 10,000 individual simulations for earnings, wages and match quality

Table 26: Welfare effects transitory house price shock.

	Shock at age 30		
	% HH	Female	Male
Homeownwers in both cases	0.54	-0.010	-0.010
Renters in both cases	0.416	-0.002	-0.011
New renters	0.034	-0.036	-0.25
	Shock at age 35		
	% HH	Female	Male
Homeownwers in both cases	0.76	-0.006	0.029
Renters in both cases	0.20	0.0	-0.001
New renters	0.030	-0.045	-0.32

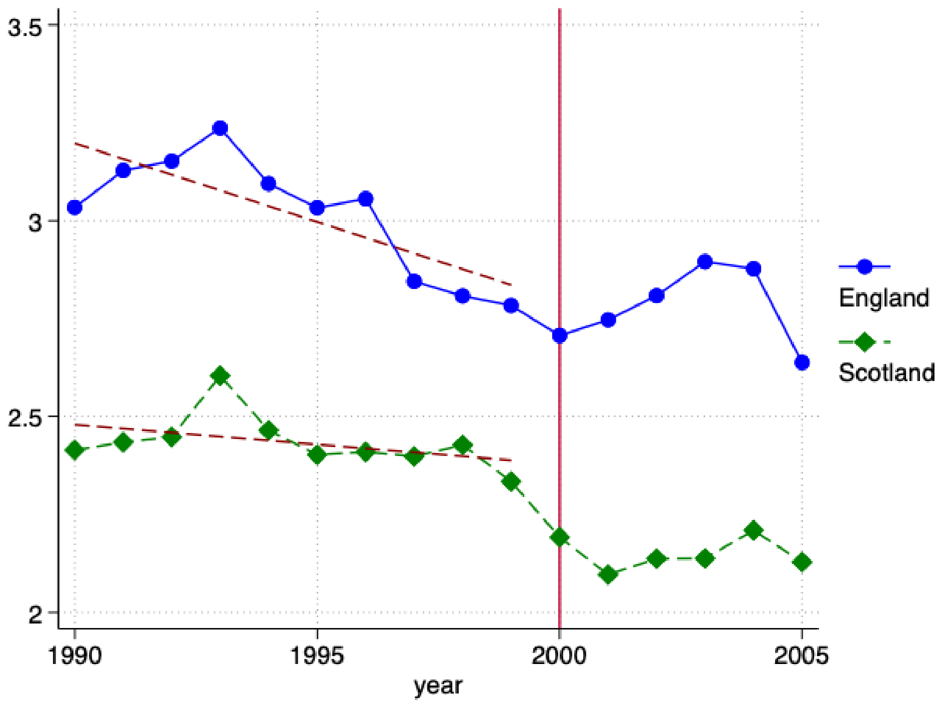
Hicksian equivalent variation for persistent 10 % increase in housing prices. All computations were done using the same set of 10,000 individual simulations for earnings, wages and match quality

D Validity of difference-in-difference

D.1 Parallel trends

We can also formally test for the parallel trends assumption on our main outcome variables (in particular married women's hours worked and employment status), by regressing the outcome variables on a full set of interactions between a dummy indicating whether the respondent is living in Scotland, *Scotland* and the year dummies. We then test common trends by statistically testing the null hypothesis that the interaction effects are null for the years before 2000 against the alternative hypothesis they are not null. This is similar to the approach taken by Piazzalunga (2017) and Ohinata and Picchio (2020). The p-value for the test with *Hours* equals 0.15, and for *Employment* it is 0.86. Hence, we cannot reject the null hypothesis and therefore we cannot reject the common trends assumption. Due to the limited number of observations, we cannot directly use the same procedure for crude divorce rates, but we present the pre-*White v. White* trends here below:

Figure 6: Crude divorce rates.



D.2 Placebo tests

Similar to Piazzalunga (2017), we conduct placebo tests, to check for the validity of the difference-in-difference estimates, used to identify parts of our structural model.

Table 27: *White v. White* and labor supply of cohabiting and single women.

	$Hours_{i,c,r,t}$	$Employment_{i,c,r,t}$	$Hours_{i,c,r,t}$	$Employment_{i,c,r,t}$
$Post \times Treated_{c,t}$	3.44	0.026	-1.05	0.042
	(2.54)	(0.053)	(1.92)	(0.037)
Observations	4,938	4,938	4,616	4,616
R-squared	0.28	0.23	0.34	0.27
Sample	Cohabiting	Cohabiting	never married	never married
Demographic (incl. spouse) controls	✓	✓	✓	✓
Year	✓	✓	✓	✓
Region	✓	✓	✓	✓
local female unemployment rate	✓	✓	✓	✓

Notes: estimation on sample of married women in age range of 25-60 years old, sample range 1992-2005. Standard errors clustered at the individual level, *** p<0.01, ** p<0.05, * p<0.1. Demographic (incl. spouse) controls includes age and age squared of the respondent, the age and age squared of the husband, the education level of the respondent, the education level of the husband; both defined as their highest qualification received, number of young children ($\leq$ 15 age old) and the household's non-labor income. Non-labor income is deflated by the CPI with 2014 as reference year.

D.3 Dynamic effects

To identify parts of our dynamic structural model, we used the average impact of the *White v. White* case on married women's labor supply. However, we can also estimate the effects of the *White v. White* case on married women's labor supply over time, in particular, we estimate:

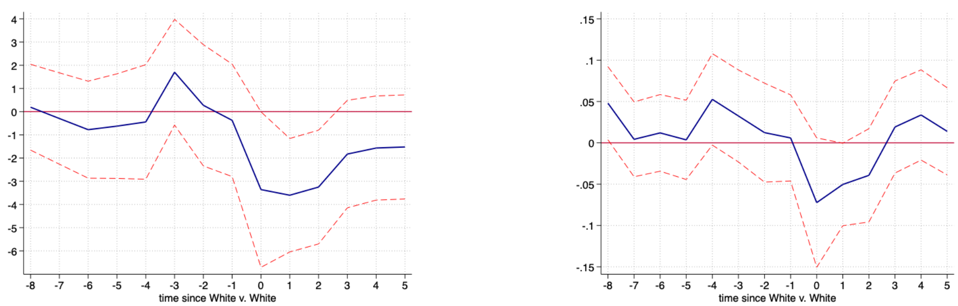
$$Hours_{i,c,r,t} = \sum_{t=1992}^{2005} \gamma_t \, Year \times Treated_{c,t} + \mathbf{X'}_{i,r,t}\gamma + \sum_t f_t + \sum_r f_r + \epsilon_{i,c,r,t}, \quad (57)$$

for hours worked and

$$Employed_{i,c,r,t} = \sum_{t=1992}^{2005} \tilde{\gamma}_t\, Year_t \times Treated_{c,t} + \mathbf{X}'_{i,r,t}\gamma + \sum_t f_t + \sum_r f_r + \epsilon_{i,c,r,t}, \quad (58)$$

for employment. The effects for hours are represented in figure 7a and for employment in figure 7b:

Figure 7: *White v. White* effect on female labor supply: dynamic effects.



(a) hours worked

(b) employed

E Extensions and robustness

E.1 Male labor supply

We can also estimate the effect of the *White v. White* case for married men. From a theoretical perspective, given that the case induced a higher bargaining power for women, together with the fact that a majority of married men work full time, we do not expect any significant changes in male labor supply. This is indeed confirmed in table 28:

E.2 Panel estimation

We also re-estimated (1) by exploiting the panel dimension in the data, which allows us to include individual fixed effects, which controls for unobserved het-

Table 28: *White v. White* and labor supply of married men.

	$Hours_{i,c,r,t}$	$Employment_{i,c,r,t}$
$Post \times Treated_{c,t}$	-0.765	0.00831
	(1.287)	(0.0132)
Observations	25,437	25,437
R-squared	0.132	0.142
Demographic (incl. spouse) controls	✓	✓
Year	✓	✓
Region	✓	✓
local male unemployment rate	✓	✓

Notes: estimation on sample of married men, sample range 1992-2005. Standard errors clustered at the individual level, *** p<0.01, ** p<0.05, * p<0.1. Demographic (incl. spouse) controls includes age and age squared of the respondent, the age and age squared of the wife, the education level of the respondent, the education level of the wife; both defined as their highest qualification received, number of young children ($\leq$ 15 age old) and the household's non-labor income. Non-labor income is deflated by the CPI with 2014 as reference year.

erogeneity that does not change over time. Clearly, in order to run such a fixed effects-panel regression we need to add some further restrictions to the baseline sample. In particular we will only preserve those respondents in the sample which we observe at least once before the year 2000 and once after. The results are given in table 29. As can be seen, the qualitative results is similar to the DiD results in table 2. The coefficient of the effect of *White v. White* is estimated with more noise and the point estimate reduces in size (to a reduction of about 1.6 hours worked per week.) These findings are again very similar to Piazzalunga (2017).

E.3 Household work

The more egalitarian distribution of assets upon divorce following *White v. White* has had a negative effect on (married) women's labor supply. It is also

Table 29: Panel estimation: *White v. White* and labor supply of married women.

	$Hours_{i,c,r,t}$	$Employment_{i,c,r,t}$
$Post \times Treated_{c,t}$	-1.61*	-0.029
	(0.885)	(0.0192)
Observations	23,068	23,068
Individual FE	✓	✓
Demographic (incl. spouse) controls	✓	✓
Year	✓	✓
Region	✓	✓
local female unemployment rate	✓	✓

Notes: estimation on sample of married women in age range of 25-60 years old, sample range 1992-2005. Standard errors clustered at the individual level, *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Demographic (incl. spouse) controls includes age and age squared of the respondent, the age and age squared of the husband, the education level of the respondent, the education level of the husband; both defined as their highest qualification received, number of young children ($\leq$ 15 age old) and the household's non-labor income. Non-labor income is deflated by the CPI with 2014 as reference year.

interesting to investigate whether there is any evidence of substitution of this freed up time towards domestic work. The BHPS asks respondents how much time they spend (on average) per week on domestic chores, which we can use as a proxy for household work. We then run a regression of household work on the same set of controls as in our main DiD specification as represented in (1).

Table 30: *White v. White* and household work.

	Household work$_{i,c,r,t}$	*Household work*$_{i,c,r,t}$
Post × *Treated*$_{c,t}$	1.50***	0.39
	(0.563)	(0.515)
Observations	26,488	26,488
Individual FE		✓
Demographic (incl. spouse) controls	✓	✓
Year	✓	✓
Region	✓	✓
local female unemployment rate	✓	✓

Notes: estimation on sample of married women in age range of 25-60 years old, sample range 1992-2005. Standard errors clustered at the individual level, *** p<0.01, ** p<0.05, * p<0.1. Demographic (incl. spouse) controls includes age and age squared of the respondent, the age and age squared of the husband, the education level of the respondent, the education level of the husband; both defined as their highest qualification received, number of young children (≤ 15 age old) and the household's non-labor income. Non-labor income is deflated by the CPI with 2014 as reference year.

Though the pooled OLS estimate in column 1 suggests a slight increase in domestic work (hence suggestive for a substitution between market and domestic work time), this effect vanishes (both in size and statistically) after controlling for individual fixed effects, i.e., unobserved heterogeneity at the individual level.

F Wages and earnings

To estimate $\sigma^2_{\epsilon^M}$ and $\sigma^2_{\epsilon^F}$, we first need estimates of $\alpha^M(t)$ and $\alpha^F(t)$. Furthermore, we explicitly wanted to control for selection into the labor market for women. First, to obtain the deterministic age-profiles in (11) and (12), we regressed the (log) of male earnings or (log) of hourly female wages on a quadratic polynomial in age, education and regional dummies and number of children in the household. For women, we first estimated a participation equation,

$$Particip_{i,t} = \mathbf{Z}'_{i,t}\gamma + \epsilon_{i,t},\ \epsilon_{i,t}^{Particip} \sim N\left(0,1\right).$$

Where we have used nonlabor income and the treatment indicator as excluded variables for the selection equation (a similar approach can be found in Voena (2015)). The probability of the wife of being active on the labor market in year t is then given by:

$$\begin{aligned} Prob\left(Particip_{i,t} = 1\right) &= Prob\left(\epsilon_{i,t}^{Particip} > -\mathbf{Z}'_{i,t}\gamma\right) \\ &= \Phi\left(\mathbf{Z}'_{i,t}\gamma\right). \end{aligned} \tag{59}$$

Adapting the system given by (55) and (56) to include selection into the labor market for women, we can obtain the parameters of the wage processes as solutions to the following system, which can be estimated using NLS:

$$\begin{cases} \mathbb{E}\left[\Delta\tilde{w}_t^F\left(\Delta\tilde{w}_{t-1}^F + \Delta\tilde{w}_t^F + \Delta\tilde{w}_{t+1}^F\right)|Particip_{t-j} = 1\right] = \\ \sigma_{\epsilon^F}^2 + \sigma_{\epsilon^F,\epsilon^{Particip}}^2 \frac{\phi(\mathbf{Z}'_t\gamma)}{1-\Phi(\mathbf{Z}'_t\gamma)},\ \text{for all } j = -1,0,1,2 \\ \mathbb{E}\left[\Delta\tilde{y}_t^M\left(\Delta\tilde{y}_{t-1}^M + \Delta\tilde{y}_t^M + \Delta\tilde{y}_{t+1}^M\right)\right] = \sigma_{\epsilon^M}^2. \end{cases}$$