



Selectivity of Bargaining and the Effect of Retirement on Labour Division in Italian Couples

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Abstract

Using Italian data on the Use of Time, in this study we analysed the influence of the bargaining process between partners on the allocation of intra-household labour after the retirement of the male partner. Adopting an appropriate procedure to identify the effect of women's bargaining power, we found that men's propensity to retire increased if women had strong bargaining power in labour division. This implies an overstatement of the effect of a man's retirement on the housework of a woman with higher bargaining power and, conversely, an understatement of the effect of the man's retirement on the housework time of a woman with lower bargaining power. To correct this selectivity effect, we estimated the effect of a man's retirement on the paid and domestic work of both partners by comparing couples in which the woman had high bargaining power and couples in which the woman had low bargaining power.

Keywords Effects of retirement · Housework division between partners · Bargaining process · Matching

Introduction

The retirement of the male partner in older Italian couples does not seem to lead to a more equitable distribution of housework between partners. Social norms and/or differences in bargaining power may explain the marked differences found in Italy with respect to other European countries (Caltabiano et al. 2016; Ciani 2016; Mills et al. 2008).¹ One possible explanation is that Italian married men have strong bargaining power and leave most of the housework to their wives, even after retirement. However, the influence of the bargaining process is difficult to specify and evaluate, considering that bargaining between partners strongly depends on their latent cultural and psychological characteristics.

Researchers have generally used proxy variables to analyse the bargaining effect in order to explain working time allocation in the household. Eckstein and Wolpin (1989) emphasized the relevance of the earning profile of each partner, while Brines (1994) and Gupta (2007) considered the "inverse" of

the measure of the partner's economic dependency given by the contribution of each partner to the household labour income. However, these approaches to evaluating the influence of bargaining did not lead to robust findings (see Baxter and Hewitt 2013; García-Mainar et al. 2011; Gupta and Ash 2008).

The aim of this study was to provide a convincing specification of the influence of bargaining in the relationship between a man's retirement and the partner's commitment in both paid and unpaid working time. In doing this, we started with the assumption that factors strongly related to women's bargaining power are represented by the degree of economic dependency and by the perception of fairness in a woman's division of labour with her male partner (fairness perception) (e.g., Blair and Johnson 1992; Caltabiano et al. 2016; Kawamura and Brown 2010).

However, women's perception of fairness regarding the division of housework time may depend on how working time is distributed among the partners. This mechanism of reciprocal dependence may involve a "reverse-causality" effect in the relationship between the man's retirement and the division of labour. Namely, if a woman with higher bargaining power wants a more equitable distribution of

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¹ However, gender construction theories still take precedence in explaining the division of housework time after retirement also in other European countries, such as Germany (cf. Leopold and Skopek 2018).

housework time with her partner, this can induce the male partner to retire earlier to have more time to devote to work in the home and family. The opposite occurs if the woman has lower bargaining power. This implies a selection effect leading to an overstatement of the effect of a man's retirement on the time devoted to housework by a woman with a higher bargaining power and, conversely, to an understatement of the effect of a man's retirement on the housework time of a woman with lower bargaining power.

In this study, we tried to solve the problem of the selectivity effect of bargaining by taking into account the extent to which the endogenous component of bargaining influences the commitment in housework and paid work of both partners, and by correcting the estimation results accordingly.

As for the empirical analysis and specification of the model, for Italy there have been no longitudinal time-use surveys aimed at evaluating the change over time in partners' division of labour. As a consequence, it has not been possible to evaluate the impact of the man's retirement by considering the intra-household allocation of time before and after this event. Longitudinal studies on the effect of retirement on intra-household work allocation in Italy have used data provided by the Generations and Gender Survey (GGS) (cf. Caltabiano et al. 2016). However, the GGS Survey does not provide detailed information on the allocation of time such as a specific survey on time use based on the diary method. The difficulty of performing a detailed longitudinal analysis did not discourage us from pursuing the aim of evaluating how the allocation of working time in the family changes if the male partner retires. We decided to analyse the effect of retirement in a cross-sectional context, along the lines followed by previous studies (see Battistin et al. 2009 and Ciani 2016, for Italy; Stanca et al. 2012, for France).

For this reason, we performed our empirical analysis by using cross-sectional time use data on older Italian couples provided by the Italian National Institute of Statistics (Istat) with reference to the years 2008–2009.² The age of the subjects examined in this survey, in particular, was compatible with the eligibility rules imposed by Italian law for early retirement on a voluntary basis. This circumstance allowed us to empirically evaluate the effects of the voluntary decision to retire.³

With respect to the studies regarding the Italian case, we would like to emphasize the role of bargaining process between partners as a result of the influence of cultural factors, for example, gender attitudes and aspects of women's

personality. The influence of these factors has been considered particularly relevant in Italy (e.g., Anxo et al. 2011). However, although the Italian case may be of particular interest for an analyst, the influence of bargaining on the relationship between retirement and labour division within the couple may be further analysed. In doing this, the problem of the selectivity effect of bargaining on retirement decision should be investigated further, adopting more specific methods to identify the effect of bargaining in a cross-sectional framework.

In order to identify the bargaining effect in a cross-sectional framework, in this study we decided to compare the working time of couples where the man had retired with the working time of couples in which the man had not retired (counterfactual situation). To this end, a matching procedure using a propensity score was adopted to link the couples belonging to each state (whether or not the male partner had retired).

By performing a matching procedure corrected for the endogeneity of bargaining, we introduced a correction term obtained by a preliminary estimate of a proxy of the woman's bargaining power as a covariate in the equation of the male partner's propensity to retire. Specifically, woman's "predicted" bargaining power was obtained by combining behavioural and cultural factors as well as the extent of woman's weight in household's income production and woman's availability of time. In doing this, two alternative estimates of woman's bargaining power were performed: (a) a latent construct obtained by a Generalized Structural Equations Model (GSEM) and (b) a Linear Probability Model (LPM) regression using women's satisfaction with labour division as a dependent variable.

We estimated the most common treatment parameters in order to evaluate the impact of the man's retirement on the time devoted to paid and domestic work by both partners. In addition, we stratified the analysis for different couple profiles, each characterized by a different level of the female partner's bargaining power. In this way, a measure of the influence of bargaining was given by the difference in the estimated housework time of households in which the woman had "more bargaining power" and households in which the woman had "less bargaining power".

As a result of this analysis, the man's retirement did not lead to a significant reallocation of the woman's working hours between paid work and domestic work, although a man belonging to a family where the woman had high bargaining power in household decisions was generally encouraged to leave work in order to devote more time to family commitments.

In the next section we present a brief survey on the findings of the most relevant studies on the relationship between partners' retirement and their bargaining in labour division. In the following paragraphs we discuss, in sequence: the

² The Time Use Survey 2008–2009 provided by Istat (Italian National Institute of Statistics) is available in the public domain at: <https://www.istat.it/it/archivio/4611>

³ Note that, over the last decade, Italian government progressively imposed stringent constraints on early retirement, making it difficult to derive an empirical support for the analysis here proposed from recent data.

rationale of our methods, the characteristics of the dataset and the sample composition, and the estimation results. Finally, we conclude with final observations and remarks.

Latent Bargaining Process in Labour Division and Decision to Retire

In this section we briefly discuss three relevant aspects of decision-making within the household that influence the bargaining process between partners and the man's decision to retire. We consider in particular personality aspects, the woman's economic dependency, and her perceived fairness of the division of labour with her partner as factors related to her bargaining power. In addition, we discuss the potential endogeneity of the male partner's decision to retire with respect to the partners' division of labour as a consequence of the influence of bargaining.

Bargaining and Personality Aspects

Early models of time allocation among a household's members were specified in terms of a unitary model that assumed that the household's components maximized a single utility function (e.g., Becker 1981). In this approach there was no notion that the partner who earned more increased his/her bargaining power, as in bargaining or exchange theory. The alternative collective approach (Apps and Rees 1997; Chiappori 1988; Donni and Molina 2018; Matteazzi et al. 2017; Menon et al. 2018) considered family members, and not the household as a whole, as core decision makers; this implies that decisions relating to production, consumption, and labour participation should be taken simultaneously by each member in an equilibrium model. The collective model of labour supply was extended to household production in the studies of Apps and Rees (1996) and Chiappori (1997). Estimations of this model were proposed by Bourguignon and Chiuri (2005) and, more recently, by Mangiavacchi and Rapallini (2014) who, to estimate the sharing rule within the household, used self-reported economic condition of the household members obtained as responses to a questionnaire related to a Time Use Survey (TUS) in Italy.

More recently, several approaches took into account the behaviour of each household member resulting from individual preferences and supported by his/her bargaining power compared to that of the other household members (e.g., McElroy and Horney 1981). This is the case, for example, of the cooperative approach that allows differences between spouses to affect household decision-making by specifying a sharing rule given by a household welfare function (e.g., Manser and Brown 1980; McElroy and Horney 1981).

An alternative approach assumes that household members may act non-cooperatively. This approach is based on

a model with individual preferences, but assumes that realized outcomes are determined by finding a Nash equilibrium in the behaviour of the household members (Lundberg and Pollak 1993).

In general, it is difficult to specify a model according to which family members adopt specific (cooperative or non-cooperative) behaviour in decision making. In reality, it is likely that different households behave in different ways, and that the household components are influenced differently by their own personality aspects, attitudes, and beliefs. Few studies have tried to combine different modelling approaches into one paradigm. One that has is the study by Del Boca and Flinn (2012), where a model of household time allocation, allowing for both efficient and inefficient household modes of interaction, was specified and estimated. This model incorporated compatibility constraints that required the utility of each household member to be no lower than it would be in the (non-cooperative) Nash equilibrium.

A study in which a cooperative/non-cooperative modelling framework similar to that of Del Boca and Flinn (2012) also included the impact of personality traits (Flinn et al. 2018). This study analysed the influence of personality traits in household time-allocation decisions and labour market outcomes. A personality traits' measurement aims to capture "patterns of thought, feelings and behaviour" that correspond to "individual differences in how people actually think, feel and act" (Borghans et al. 2008). In practice, personality traits measure individual openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (the opposite of emotional stability).⁴ In the above-cited study (Flinn et al. 2018), personality traits operated as potential determinants of the bargaining power of each partner jointly with education and cognitive ability. More specifically, personality traits gave a relevant contribution to the determination of the so-called Pareto's Weights in order to quantify to what extent cooperative behaviour prevails between the partners.

Economic Dependency

In several time allocation studies, researchers have assumed that the bargaining power of the household members also depends on their own level of economic dependency (e.g., Brines 1994; Gupta 2007). In particular, the dependency model of the division of domestic work is based on the assumption that household labour is provided by a household member in return for economic support. According to this view, for example, since most married women earn less than

⁴ These are the so-called Big Five traits, the most commonly used measures of personality to study the interface between Psychology and Economics (Borghans et al. 2008).

their husbands and depend on them to some extent for support, wives continue to perform most of the domestic tasks (see Brines 1994). According to this model, an exchange relation between (dominant) breadwinners and (dependent) partners occurs: money is exchanged for domestic labour under an implicit contract stipulating the rights and obligations of parties.⁵

In other studies, analysts found a positive impact of the woman's availability of time on her bargaining power (see Bertocchi et al. 2014). This implies the presence of a pattern of specialization within the household that explains why an inverse relationship occurs between the woman's commitment to paid work and her bargaining power in decision making. On the other hand, the woman's weight in the household decisions is positively correlated to her ability in terms of income production, as well as in the above cited economic dependency models. In sum, according to this approach, women that wield high weight in household decision making show, jointly, low commitment in paid-work, and high available income.

In our model we specified a bargaining equation that took into account a measure of women's economic dependency and a proxy variable of their availability of time (leisure time).

Satisfaction with Household Labour Division and Woman's Perceived Fairness

Perception of equity is another factor considered by researchers in explaining division of labour within the family. Kawamura and Brown (2010), assuming that a higher perception of the equitable treatment of women in the division of labour implies a balanced division of housework tasks in the family, modelled the woman's perception of fairness as a dichotomous response variable depending on both the wife's perception of how much she mattered to her husband and the partner's share of household work. Providing estimation results, they showed that "mattering" was significantly positively related to perceived fairness.

Perception of equity in partners' division of labour is strictly related to the influence of gender attitudes and social norms. Several socioeconomic analyses have investigated how social norms affect the division of labour between partners. Especially in Southern European countries, gendered social norms influence the structure of the welfare state by leading to a division of labour between state, market, and family, in which family and domestic work are carried out

predominantly by women (Jurado Guerrero and Naldini 1996; Saraceno 1994). In particular, Chiappero-Martinetti (2005), analysing Italian microdata on the use of time and on individual well-being, observed a stronger relationship between gendered division of labour and several specific indicators of well-being, mainly relating to health, education and knowledge, and psychological state.

Similarly, in our analysis we took into account the woman's perceived fairness of treatment, related to her weight in household decisions. In particular, we assumed as a proxy of the woman's perceived fairness of treatment the degree of her satisfaction with housework division, here measured by a dichotomous dummy variable, equal to zero if the woman was "dissatisfied" with housework division in the family, and equal to one if she was "satisfied".

Endogeneity of the Male Partner's Retirement Decision

Along these lines, in our analysis we assumed personality aspects, economic dependency, and perceived fairness in labour division to be relevant components of the woman's bargaining power, as to influence on the man's decision to retire.

However, because the bargaining process in labour division affects the decision of partners to retire, the estimation of the effect of retirement on the intra-household's allocation of time is contaminated by a selectivity effect, given the circumstance that a man's propensity to retire may increase in couples in which the woman has higher bargaining power.

In order to solve the problem of endogeneity of the retirement decision in labour allocation within the couple, analysts have adopted several remedies based on the use of control variables. For instance, Blau (1998) specified potentially endogenous explanatory variables as time-lagged regressors. Blau and Riphahn (1999) used covariates measuring financial incentives, health, and preferences to control for unobserved couple-specific heterogeneity. Stancanelli and Van Soest (2012), using cross-sectional time-use data, specified a recursive model of retirement and time allocation of the two partners, endogenizing both time allocation between partners and the man's retirement. Caltabiano et al. (2016), using longitudinal data drawn from the Italian Gender and Generation Survey (*GGS*), adopted a residual-based correction of the influence of omitted variables, as in a Seemingly Unrelated Regression model (*SUR*), to obtain correct estimates of the simultaneous paid and unpaid work equations of both partners.

In our analysis, we tried to specify an equation explaining the bargaining power of the woman taking into account the factors discussed previously related to psychological condition and personality, the degree of economic dependency, and the perception of her weight in household decision

⁵ The nature of this contract, however, departs substantially from that of paid labour in the labour market, in which remuneration varies in proportion to the effort expended. In addition, unlike the labour-market rule, the dependent cannot easily change the employer (breadwinner).

making. As a result of the estimation of the bargaining equation, we obtained predicted values of bargaining that we introduced as explanatory variables in estimating the retirement propensities of the male partners. In doing this, we adopted two distinct methods to identify woman's bargaining power, and compared the results. The rationale of the strategy in our empirical analysis and a detailed description of the adopted estimation methods will be extensively discussed in the following section.

Model Specification and Estimation

The aim of this empirical analysis was to evaluate the extent to which the time spent on housework tasks differed between couples in which the male partner was retired and couples in which he was not. This comparison was based on a propensity-score matching method that allowed us to link couples characterized by a different status of the man (whether or not he is retired). In doing this, each man's propensity to retire was obtained as a predicted value of the estimation of a discrete choice equation (using Probit), whose dependent variable was a dichotomous dummy equal to one if the male partner was retired (retirement equation).

In order to correct the estimation results of the retirement equation for the selectivity effect of bargaining, we simultaneously estimated the retirement equation and a further bargaining equation, implementing a two-stage procedure. The bargaining equation allowed us to identify and estimate, at the initial stage, the bargaining weight of the woman in household decision-making. Predicted values of the bargaining equation were used, at the second stage, as an explanatory variable in the male-retirement Probit equation.

At the first stage, the bargaining equation was specified as follows:

$$B_i^* = z'_{bi}\beta_b + u_{bi} \quad (1)$$

In Eq. (1), z'_{bi} is a row vector, showing, for each observation, the values of the variables influencing bargaining. β_b is a vector of coefficients, u_{bi} an independent error term with zero mean. Regarding the specification of the dependent variable, we proposed, alternatively, two different proxies of a woman's bargaining power. In particular, we indicated the dependent variable as a dummy, B_i^S , signalling whether the woman was satisfied with the division of labour with her partner (perception of equity); it was equal to 1 if the woman was satisfied, and to 0 otherwise.

As an alternative specification of a woman's bargaining power, we indicated as B_i^L a variable obtained as a result of a latent construct based on the contribution of structural variables, such as the woman's economic dependency and perception of equity, and of measurement variables

given by proxies of a woman's personality aspects, education, health and leisure time. The latent variable B_i^L was obtained by performing a Generalized Structural Equations Model (*GSEM*) (see Skrondal and Rabe-Hesketh 2004). In particular, we performed one single-factor measurement model and then calculated the predicted value of the latent construct. Our measurement model allowed us to understand how a certain set of indicators fitted together in order to create variables that represented a latent construct. In doing this, both endogenous (measurement) and exogenous (observed) variables were considered. In this case, the indicators or manifest variables of the latent construct were caused by the latent variable. For the structure of our model, the observed exogenous determined latent variable (here identified as Bargaining), and Bargaining in turn determined the observed endogenous indicators, as in a Multiple Indicators and Multiple Causes Model (*MIMIC*) (Jöreskog and Goldberger 1975). Moreover, the measurement variables were not continuous, but codified as 0 and 1, and we used the *Probit* estimations for these dummy variables.

The aim of the specification of the *GSEM* model was to obtain, as a predicted latent variable, a continuous variable positively correlated to the bargaining power of the woman.

At the second stage, the retirement equation was specified as a *Probit* model, as follows:

$$R_i^* = \alpha \hat{B}_i^* + z'_{ri}\beta_r + u_{ri} \quad (2)$$

with $R_i = 1$ (partner retired) if $R_i^* > 0$, and $R_i = 0$ if the partner had not retired. \hat{B}_i^* is a proxy of the woman's bargaining power obtained at the first stage by estimating, alternatively, three different models whose predicted values were, respectively \hat{B}_i^S and \hat{B}_i^L . In addition, we assumed that the man's decision to retire, R_i , depended on the row vector of covariates z'_{ri} ; the error term u_{ri} was normally distributed $N(0, 1)$.

The stochastic specification of the bargaining Eq. (1) changes in function of the choice of the dependent variable. If we use the proxy \hat{B}_i^S indicating the woman's satisfaction with labour division, the equation (Eq. 1) is specified as a Linear Probability Model (*LPM*). As an alternative, we can obtain \hat{B}_i^L as a latent factor proxy of the woman's bargaining power by performing a *GSEM-MIMIC* procedure (see below, the Section on the "Estimation Results").

In a further step of our estimation strategy, we used the predicted propensities of the man to retire, obtained by estimating the retirement equation (Eq. 2), to link partners with a different retirement status. Therefore, we linked "treated" and "untreated" women (or men) belonging to couples characterized by the same estimated propensity of the man to retire. In this way, we could compare the time

devoted to housework and paid work, respectively, by each subject with the time devoted by his/her counterfactual.

Because in a propensity-score matching procedure the identification of the selection rule (the decision of the male partner to retire) depends on the specification of the selection equation (e.g., Rosenbaum and Rubin 1983), we are confident that the correction for selectivity, provided by the first-stage bargaining estimation, helps us to control the estimation of the propensity scores for the influence of latent factors related to the bargaining process.

In the next section we explain in detail the procedure used to estimate the propensity scores and discuss the properties of the estimated parameters in evaluating the effect of retirement on partners' working activity. Moreover, we discuss the rationale of a specific approach to evaluate the extent to which selectivity influences the matching results. In particular, we evaluate the sensitivity of matching results to different specifications of the bargaining equation (Eq. 1).

Estimating the Effects of Retirement on Household Members' Paid and Unpaid Work

In order to perform the model estimation, we used a sample of married (or cohabiting) couples composed of $n = n_0 + n_1$ observations, where a group of n_1 ("treated") couples had experienced the retirement of the male partner, while n_0 couples belonging to a comparison group had not experienced this event ("untreated" couples).

The parameters considered to evaluate the effect of the man's retirement on both domestic work and paid work were the Average Treatment Effect (*ATE*), the Average Treatment Effect on Treated (*ATT*), and the Average Treatment Effect on Untreated (*ATU*). $ATE = E(y_{1i} - y_{0i})$ can be defined as the expected variation of the time devoted to housework, y_{1i} , as an effect of the man's retirement for a subject belonging to a couple randomly chosen from one of the two regimes (male partner retired or not). $ATT = E(y_{1i} - y_{0i}) | R = 1$ and $ATU = E(y_{1i} - y_{0i}) | R = 0$ can be defined as the expected variations of the housework time, respectively, for subjects belonging to couples who have experienced the partner's retirement and subjects belonging to couples who have not.

In applying a matching estimator, we checked whether the condition of "ignorability" (robustness of the estimates with respect to the influence of unobservable factors) held. To this end, we assumed the relative difference between *ATT* and *ATU* as a measure of the influence of unobserved heterogeneity due to hidden factors (cf., among others, Xie et al. 2012). Following this line, a Heterogeneity Indicator given by the ratio $HI = (ATT - ATU) / SE_{(ATT - ATU)}$ was adopted. Higher values of this indicator signal that the estimation procedure has not provided a satisfactory reduction of the

hidden influence of omitted variables between treated and untreated units (*Heterogeneity bias*).⁶

The matching algorithm here applied is given by the "Nearest-Neighbor Within a Caliper, Without Replacement" (Guo and Fraser 2015), which combines two traditional matching criteria. The first criterion is given by the application of the Nearest Neighbor Matching, in which a control unit is matched to a treatment case if the difference in the propensity score is the smallest among all possible pairs of propensity scores between treated and control units. The second criterion, Caliper Matching, imposes a further restriction as a tolerance level, τ (the caliper to each matching method), regarding the distance between treated and control units. In particular, we matched treatment and control cases within the caliper or the tolerance level equal to $\tau = 0.05$. The caliper size, as suggested by Rosenbaum and Rubin (1985), must not exceed a value equal to a quarter of the standard deviation of the sample estimated propensity scores σ_p ($\tau \leq 0.25 \sigma_p$). In our case, the standard deviation of the sample estimated propensity scores σ_p was equal to 0.2948. Hence we chose a caliper (0.05) lower than $0.25 \sigma_p = 0.0737$.

In addition, the Balancing Score test on the difference in covariates between treated and untreated subjects after matching also checked the misspecification of the propensity score model. If there remain systematic differences in baseline covariates between treated and untreated subjects after matching, this may be an indication that the propensity score model has not been correctly specified (cf. Austin 2011, among others). The results of the balancing score test are presented in the "Appendix".

The Data

Data came from the Time Use Survey 2008–2009 provided by *Istat* (Italian National Institute of Statistics). This data, surveyed using the "diary method", allowed us to analyse how people allocated their time during a day.⁷ In our analysis, the sample was comprised of 3126 women, married or cohabiting, equitably distributed by area of residence. The age of their male partner ranged from 50 to 65 years (age compatible with eligibility for retirement). The men were either employed or retired. There were 1030 women with a

⁶ The values of the standard normal distribution can be taken as a reference for the evaluation of the level of heterogeneity measured computing the *HI* statistics. If the *HI* statistic provides (positive or negative) values close to zero, this indicates a low level of heterogeneity. The opposite occurs with higher values (positive or negative) of the index.

⁷ The subjects in our sample were interviewed between Monday and Saturday.

retired partner (33%), while 414 of the women were retired (13%). There were also 281 couples in which both the man and woman were retired (9%).

Explanatory variables used in the model provided demographic and socioeconomic information on the subjects such as the woman's age (*Woman's age*), the man's age (*Man's age*), the woman's education (*Woman's edu*) and the man's education (*Man's edu*) and the man's health status (*Man's health*: 1 = if man suffered from long-term health problems or chronic disease, 0 = otherwise), whether the couple lived in Northern-central Italy or in Southern Italy (*Area*), whether any children still lived at home (*Children*: 1 = yes; 0 = otherwise). Other variables addressed the woman's working status (*Woman retired*: 1 = yes; 0 = otherwise).

In order to explain the woman's personality aspects, we used two variables that could be considered as proxies of the influence of the relational context. The first was a dummy variable signalling the frequency of church or place of worship (*Religiosity*: 1 = if the woman goes to a church or another place of worship every day, various times a week, once a week; 0 = otherwise).⁸ The second was a dummy variable that helped us to understand the subject's level of physical and mental health (*Worried*: 1 = if, thinking back over the past three years, the woman had trouble in managing her time; 0 = otherwise). We also included a dummy variable as a measure of the woman's economic dependency, that assumed the value of 1 if the woman provided for family maintenance to a greater extent (*Economic dependency*). We also introduced a dummy variable that assumed the value of 1 if the family received paid help in domestic work (*Help received*: 1 = yes; 0 = otherwise). Another variable related to the bargaining power of the woman was given by her leisure (*Woman's leisure*), measured by the time (in minutes) devoted to leisure activities daily.

Finally, as suggested by Stancanelli and Van Soest (2012), we introduced a dummy variable indicating the man's eligibility for retirement (dummy *R_eligibility* that took the value of 1 if the man's age was more or equal to the age of eligibility, namely age 58 in the years 2008–2009).⁹ In addition, we constructed a series of “interaction-variables” given by the

difference between the man's age (if higher than 58) and the “eligible” age 58, multiplied by the dummy *R_eligibility*.¹⁰

In Table 1 we present the description of variables used in our analysis. In Table 2, various descriptive statistics regarding these variables are provided.

Estimation results

In this section we discuss the estimation results of our procedure. In the first step, we provided two alternative estimates of woman's bargaining power by adopting two different models (see above, Eq. 1). In the second step, we estimated, by *Probit*, the propensity scores of retirement as specified above in the equations (Eq. 2), including, alternatively, as a correction term for selectivity one of the two proxies of the woman's bargaining power, obtained as predicted values by the first-step estimates (see Fig. 1 and Table 6). In the third step, we estimated the matching parameters (*ATT* and *ATU*, in particular) measuring the effects of the man's retirement on both the housework and paid-work time of both partners. In doing this, we evaluated the extent to which matching parameters changed between the two groups given, respectively, by the households in which the woman had a higher bargaining power and the household in which the woman had a lower bargaining power. A criterion for classifying the families according to the woman's bargaining power was also provided.

We report the estimation results of the Bargaining Equation (Eq. 1) obtained by applying a *GSEM* model in the following path diagram (Fig. 1).

The estimation results of *GSEM-MIMIC* (Fig. 1) procedure showed that a latent factor (assumed as a proxy of woman's bargaining power) was inversely related to the dummy signalling if the woman contributed to the production of income to a greater extent than her partner (variable: *Economic dependency*. The corresponding coefficient's value was equal to -0.74). On the other hand, the woman's bargaining power was positively related to the woman's time availability (variable: *leisure*). In addition, the *GSEM-MIMIC* estimation showed that the woman's latent bargaining power inversely depended on exogenous variables such as education and religiosity, and positively on health status and presence of children in the family. Factors such as worry (concern in managing time spent at

⁸ Several studies suggest that a strong and positive association exists between religion and marital quality (Myers 2006) and between religion and life satisfaction (Snoep 2008; Swinyard et al. 2001). Moreover, through attendance of religious services the subject can build friendships and social networks (Lim and Putnam 2010). Also Mencarini and Sironi (2012) argue the positive effect of religion in building social networks. Lehrer (2004) and Snoep (2008) underline the positive effects of religion on physical and mental health.

⁹ In the period of the survey, the minimum of 58 years of retirement age was introduced.

¹⁰ Variables explaining eligibility have been introduced as exogenous regressors in the “Regression Discontinuity” approach to the estimation of the effect of retirement (cf. Battistin et al. 2009; Ciani 2016; Jurado Guerrero and Naldini 1996; Stancanelli and Van Soest 2012). Using the Regression Discontinuity model, these variables serve to identify the separation point between the decision to remain in the workforce and the decision to retire.

Table 1 List of variables

Dependent variables	
B = Bargaining:	
B_i^s	Dummy: if the woman is satisfied with housework division with partner = 1
B_i^L	Latent variable common to factors measuring qualities of the woman
R = Retirement	
	Dummy: if the man is retired = 1
Explanatory variables	
Woman's edu	Woman's education (Years)
Man's edu	Man's education (Years)
Woman's age	Age of the woman
Woman's age 2	Square of woman's age
Man's age	Age of the man
Area	Dummy: 1 if the family lives in the Southern Regions and Islands, 0 otherwise
Children	Dummy: 1 if children still live at home, 0 otherwise
Man's health	Dummy: 1 if the man suffers from diseases, 0 otherwise
Help received	Dummy: 1 if the family receives paid help, 0 otherwise
Religiosity	Dummy: 1 if the woman goes to a church or other place of worship every day, various times a week, once a week, 0 otherwise
Worried	Dummy: 1 if the woman feels worried about her work, 0 otherwise
Economic dependency	Dummy: 1 if the woman's earnings are higher than her male partner's, 0 otherwise
Woman's leisure	Minutes devoted to leisure activities by woman
Woman retired	Dummy: 1 if woman is retired, 0 otherwise
Woman's health	Woman's health status: 1 = very poor—5 = excellent
R_eligibility	Dummy: retirement eligibility = 1 if he is 58 years old, at least, 0 otherwise
R_eligibility* (Age-58)	Interaction between the retirement eligibility and age

Table 2 Summary statistics on variables

	All (obs. 3126)		Man not retired (obs. 2096)		Man retired (obs. 1030)	
	Mean or %	SD	Mean or %	SD	Mean or %	SD
Woman's domestic work	350.52	163.27	353.31	166.87	344.83	155.62
Woman's work	83.51	173.16	101.97	185.87	45.95	136.45
Man's domestic work	121.5	135.54	96.94	122.82	171.49	146.13
Man's work	177.37	242.77	262.51	254.99	4.12	42.43
Woman's edu	9.72	3.97	10.23	3.97	8.7	3.77
Health's woman	3.68	0.71	3.73	0.71	3.58	0.71
Woman's age	53.44	5.89	51.56	5.41	57.27	4.89
Man's age	57.23	4.5	55.4	3.95	60.96	2.98
Area	0.38		0.42		0.31	
Children	0.47		0.38		0.66	
Religiosity	0.4		0.37		0.47	
Satisfaction	0.6		0.56		0.67	
Economic dependency	0.07		0.06		0.08	
Worried	0.31		0.34		0.24	
Bargaining	0.32	0.14	0.3	0.14	0.35	0.13
Woman's Leisure	263.73	140.55	248.92	136.75	293.88	143.4
Man's health	0.19		0.16		0.24	
Help received	0.06		0.08		0.03	
Woman retired	0.13		0.06		0.28	
R_eligibility	0.49		0.29		0.89	

We report the standard deviation for continuous values only

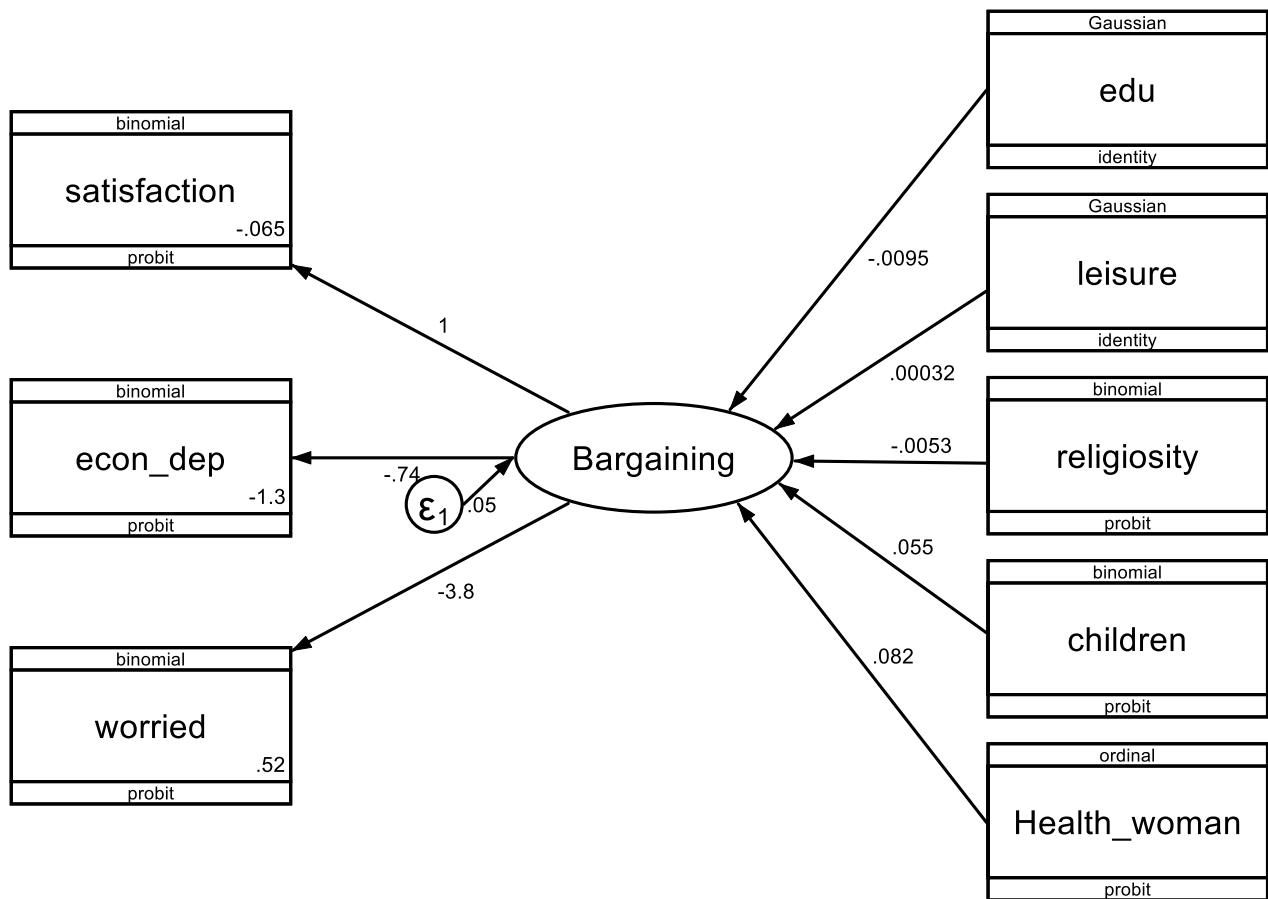


Fig. 1 Path diagram of the GSEM-MIMIC estimation procedure of latent woman's bargaining power

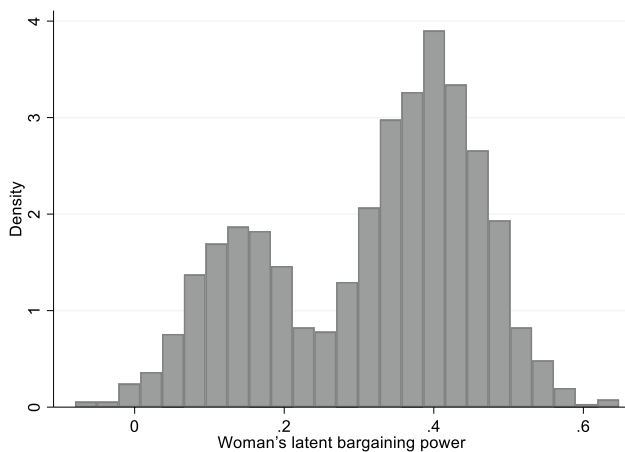


Fig. 2 Distribution of woman's latent bargaining power estimated by GSEM-MIMIC

Table 3 Classification of variables by level of woman's bargaining power

	Cluster1		Cluster2	
	(Lower bargaining power)		(Higher bargaining power)	
	Mean	S.E	Mean	S.E
Woman's bargaining power (latent)	0.14	0.002	0.403	0.002
Woman's leisure	236.03	4.230	277.3	3.077
Propensity of man to retire	0.247	0.008	0.37	0.007
No. of observations	1028		2098	

work) and religiosity can be considered as related to psychological condition and to the personality of the woman. We observed that bargaining power was inversely related to the woman's education and that it was higher if the woman's ability in income production prevailed. This is due to the fact that education and ability in income

Table 4 Estimation results of woman's bargaining power using linear probability model

Dependent variable	Woman's satisfaction with housework division ^a	
	Coef	p
Explanatory variables		
Intercept	0.426	***
Woman's edu (years of schooling)	0.003	
Religiosity: 1 if the woman attends church	0.038	*
Children living in the family: 1 yes	0.026	
Worried: 1 if the woman feels worried about her work	-0.100	***
Woman's Economic Dependency	0.022	
Leisure	0.0001	
Health's woman: 1 = very poor—5 = excellent	0.036	**
AIC	4384.448	
BIC	4432.828	

AIC is the Akaike criterion; BIC is the Bayesian criterion

^aDummy: 1 = woman is satisfied (No. 1865 cases)

* $p < .05$; ** $p < .01$; *** $p < .001$

production were higher for women who worked outside the home. In this case, the reduction of availability of time due to the commitment in paid work may negatively influence the woman's responsibility in household's decision making (see above, Bertocchi et al. 2014).

We show in Fig. 2 a histogram chart of the distribution of the woman's latent bargaining power estimated by *GSEM-MIMIC*.

As shown in Fig. 2, the distribution of the latent variable, estimated by *GSEM-MIMIC*, identifies a mixture of two distributions, characterized by two different central values (Table 3). This led us to think that our sample could be partitioned into two groups characterized by a different average level in the woman's predicted bargaining power. We then performed a clustering algorithm (Centroid-Linkage) in order to obtain a partition of the sample into two homogeneous groups.

The two clusters, obtained from the partition of the latent variable assumed as a proxy of the weight of woman in household's decision making, identify the group of women with lower power (Cluster 1) and the group including women with higher power (Cluster 2) respectively. An indirect confirmation of this interpretation was obtained by the classification of the amount of the woman's leisure time, shown in Table 3: Women belonging to the group denoted as Cluster 1 had less leisure time than women belonging to the group denoted as Cluster 2. Note that, as reported in Table 3, the predicted propensity of the man to retire, as resulting from the estimation of retirement equation (Table 6), was higher for men belonging to families included in Cluster 2,

Table 5 Estimation results of Woman's Bargaining power using GSEM-MIMIC construct

	Woman's bargaining power	
	Coef	p
Indicators		
Satisfaction	1 (constrained)	
Economic dependency	-0.739	*
Worried	-3.808	**
Control variables		
Woman's edu (years of schooling)	-0.010	**
Religiosity	-0.005	
Children living in the family	0.055	**
Leisure	0.000	**
Health's woman	0.082	**

* $p < .05$; ** $p < .01$; *** $p < .001$

namely, the group in which women had greater weight in decision making.

Tables 4 and 5 show the estimation results of the bargaining equation using the dummy signalling the satisfaction of the woman with intra-household labour division as dependent variable. We adopted the *LPM* model as an estimator in order to simplify interpretation of the estimates. As a result, we found that the woman's bargaining power was significantly impacted by the difficulty in managing work time, which in turn influenced the woman's satisfaction with labour division (dummy: *Worried*). As previously reported in the *GSEM-MIMIC* results, the variable *Worried* was particularly relevant in explaining the weight of women in the decision-making process.

Estimation of the Effects of Retirement on Partners' Working Time

In the following Table 6 we report the *Probit* estimation results of the man's decision to retire. We proposed two different specifications of the *Probit* equation, alternatively including in the set of covariates as a correction term for selectivity, the predicted values, \hat{B}_i^L , of the woman's latent bargaining power (estimated by *GSEM-MIMIC*) and the predicted values, \hat{B}_i^S , of the woman's satisfaction with the division of the housework with her partner.

Note that, when performing the two alternative Retirement-Probit regressions, no relevant differences occurred in the estimated coefficients except for the coefficient of the correction term of \hat{B}_i^L and \hat{B}_i^S , which was found to be higher when using \hat{B}_i^S as a correction variable. In general, the influence of covariates such as the retirement of the woman, the man's eligibility to retire, or the geographical area of residence provided the same results in both models. The man's

Table 6 Estimation results of retirement equation

Explanatory variables	Dependent variables: retirement		Correction term	
			Bargaining <i>MIMIC</i>	Satisfaction <i>LPM</i>
	Coef	p	Coef	p
Intercept	– 15.745	***	– 16.119	***
Bargaining [^] <i>MIMIC</i>	0.775	***		
Satisfaction [^] <i>LPM</i>			1.517	**
Education of woman (years of schooling)	– 0.019	*	– 0.029	***
Age of woman	0.124		0.118	
Age [^] 2 of woman	– 0.001		– 0.001	
Age of man	0.201	***	0.200	***
Area of residence: 0 = North-Centre; 1 = Southern regions ^a	– 0.284	***	– 0.294	***
Paid help received: 1 = yes ^a	– 0.525	***	– 0.519	***
Health's man: 1 = Sick ^a	0.178	*	0.176	*
Woman retired: 1 = yes ^a	0.452	***	0.457	***
Retirement Eligibility of man (<i>Eligibility</i>) = 1 if he is 58 years old, at least ^a	0.454	***	0.449	***
Eligibility *(Age-58)	0.114		0.114	
Eligibility *(Age-58) ²	– 0.089	*	– 0.089	*
Eligibility *(Age-58) ³	0.009	*	0.009	*
AIC	2585.255		2588.456	
BIC	2669.920		2673.121	

AIC is the Akaike criterion; BIC is the Bayesian criterion. (^a) dummy variable

*p < .05; **p < .01; ***p < .001

Table 7 Estimated effects of the man's retirement on the partners' division of labour (minutes in a day)—Full sample, comparison between different correction methods

Matching estimators:	ATT	SE	ATU	SE	ATE	SE	HI
Domestic work of woman							
GSEM Latent	– 22.58	8.853	– 21.05	8.361	– 21.774	8.38	– 0.126
LPM Satisfaction	– 17.952	9.005	– 20.984	8.585	– 19.549	8.595	0.244
Domestic work of man							
GSEM Latent	96.747	7.502	91.871	6.914	94.177	7.048	0.478
LPM Satisfaction	96.159	7.409	88.302	6.929	92.021	6.992	0.774
Paid work of woman							
GSEM Latent	– 3.814	8.586	– 9.05	8.496	– 6.573	8.32	0.433
LPM Satisfaction	– 15.317	8.668	– 22.354	8.495	– 19.023	8.34	0.58
Paid work of man							
GSEM Latent	– 252.452	9.274	– 261.122	9.73	– 257.02	9.159	0.645
LPM Satisfaction	– 268.762	9.351	– 262.782	9.675	– 265.612	9.205	– 0.444

HI Heterogeneity Indicator, given by the standardized difference: $HI = (ATT - ATU) / SE_{(ATT - ATU)}$

propensity to retire was higher in the North-Centre, and was positively related to retirement of the female partner, while it was negatively related to the help received in terms of domestic work. *AIC* and *BIC* statistics indicated a preference for the model adopting latent bargaining, \hat{B}_i^L , as correction term.

After discussing the results of the propensity scores, we focused on the estimation of the effects of the man's retirement on the intra-household allocation of work, using a

matching procedure. In Table 7, we show the estimates of the matching parameters of the full sample. In addition, we evaluated the effect of retirement separately for the two sub-samples obtained based on the different level of the woman's bargaining power (Table 8).

Estimation results suggested that the effect of the man's retirement involved a partial reallocation of the intra-household housework time in the woman's favour, even if the

Table 8 Estimated effects (GSEM-MIMIC corrected) of the man’s retirement on the partners’ division of labour (minutes in a day)—comparison between full sample and subsamples of women with low bargaining power and high bargaining power, respectively

Matching estimators	ATT	SE	ATU	SE	ATE	SE	HI
Domestic work of woman							
All	-22.58	8.853	-21.05	8.361	-21.774	8.38	-0.126
Low bargaining	-15.939	15.483	-20.046	14.963	-18.101	14.866	0.191
High bargaining	-20.711	10.602	-17.617	10.16	-19.081	10.061	-0.211
Domestic work of man							
All	96.747	7.502	91.871	6.914	94.177	7.048	0.478
Low bargaining	90.254	14.329	81.416	13.835	85.601	13.741	0.444
High bargaining	102.678	8.74	93.936	7.992	98.072	8.146	0.738
Paid work of woman							
All	-3.814	8.586	-9.05	8.496	-6.573	8.32	0.434
Low bargaining	-2.284	17.558	-10.183	17.712	-6.442	17.157	0.317
High bargaining	-9.218	9.533	-14.064	9.364	-11.771	9.204	0.363
Paid work of man							
All	-252.452	9.274	-261.122	9.73	-257.02	9.159	0.645
Low bargaining	-260.152	17.004	-258.311	18	-259.183	16.862	-0.074
High bargaining	-262.844	11.42	-266.426	11.613	-264.731	11.181	0.22

HI=Heterogeneity Indicator, given by the standardized difference: $HI = (ATT - ATU) / SE_{(ATT - ATU)}$

Table 9 Estimates of the average housework and paid-work time of the woman and man (minutes in a day) after the man’s retirement

	Average housework time				Average paid-work time			
	Yes A(T)	No A(UT)	Diff	Student-t	Yes A(T)	No A(UT)	Diff	Student-t
Women								
All	345.21	367.79	-22.58	-2.55	64.58	68.4	-3.81	-0.44
Low bargaining	341.98	357.92	-15.94	-1.03	100.66	102.94	-2.28	-0.13
High bargaining	349.83	370.55	-20.71	-1.95	50.57	59.79	-9.22	-0.97
Men								
All	182.18	85.43	96.75	12.9	3.19	255.64	-252.45	-27.22
Low bargaining	196.7	106.45	90.25	6.3	3.15	263.3	-260.15	-15.3
High bargaining	180.02	77.35	102.68	11.75	3.25	266.09	-262.84	-23.02

A(T) average time of treated (man retired), A(UT) average time of untreated (man not retired)

overall commitment of partners in domestic work remained unbalanced and unfavourable to the woman.

In more detail, the estimation results for the full sample showed a modest reduction in the woman’s housework time as an effect of the male partner’s retirement. In Table 7 we show a comparison between the parameters measuring the effect of retirement obtained by adopting the two different correction methods suggested here. The ATT parameter measuring the effect on the woman’s domestic work was equal to -22.6 min a day adopting the GSEM-MIMIC procedure to correct the estimates for selectivity of bargaining. Similar results were obtained by applying a correction method based on the woman’s satisfaction LPM estimate (-17.95). Conversely, the man’s domestic work increased by 96.75 min using GSEM-MIMIC, and by 97.35 min applying as a correction term the LPM estimate of Satisfaction. The standardized differences between ATT and ATU (HI

indicator) showed values inside the traditional critical values of the normal standard distribution. In general, the HI indicator performed well when we applied the GSEM-MIMIC correction, as the results reported in Table 7 show.

In particular, Table 8 reports the estimated matching parameters from the subsamples of women with low and high bargaining power, respectively, as previously obtained by applying a clustering partition based on GSEM-predicted bargaining power. We observed a major reduction in domestic commitment for women with high bargaining power compared to women with low bargaining power (a reduction of 21 min and 16 min, respectively, as an estimated ATT). Contextually, the man’s housework time increased by an average of 97 min per day (103 min for women with high bargaining power).

As a confirmation of the permanence of a marked gendered gap in housework division, we found that the average

Table 10 Relative contribution of the woman to domestic, paid and total work in the household

	Relative contribution					
	Domestic work		Paid work		Total activities	
	Man retired A(T) (%)	Man not retired A(UT) (%)	Man retired A(T) (%)	Man not retired A(UT) (%)	Man retired A(T) (%)	Man not retired A(UT) (%)
All	– 30.90	– 62.30	– 100.00	57.80	– 37.70	– 12.20
Low bargaining	– 27.00	– 54.20	– 100.00	43.80	– 37.80	– 11.00
High bargaining	– 32.00	– 65.50	– 100.00	63.30	– 37.20	– 11.20

Computed using the Sørensen and McLanahan (1987) formula: (man's hours–woman's hours)/(man's hours + woman's hours)%

A(T) average housework time of treated (man retired), A(UT) average housework time of untreated (man not retired)

time devoted daily to domestic work by a woman after the man's retirement was approximately 345 min, while the mean score of time dedicated by the man was approximately 182 min (Table 9).

However, the gender gap is shown differently if we stratify the analysis as a function of the woman's level of bargaining power. The commitment to domestic work of women whose partner was retired (AT) and who had less bargaining power (342 min in a day) was lower than the commitment of women with more bargaining power (349 min). A superficial evaluation of this result could lead to inconsistent conclusions about the influence of bargaining on intra-household labour division. Namely, when we considered the total amount of domestic and paid work engaged in by women whose partner was retired, we obtained a total of 433.87 min (341.98 + 100.66) for women with low bargaining power, and a total of 400.40 min (349.83 + 50.57) for women with high bargaining power. Similarly, the total amount of domestic and market work for women whose partner was not retired stands at 460.86 min (357.92 + 102.94) for women with low bargaining power, and at 430.33 min (370.55 + 59.79) for women with high bargaining power.

These results clarify that women with higher bargaining power were advantaged in terms of total work time compared to other women by about 36 min a day; this differential showed few variations related to whether the male partner was retired (– 42 min a day) or not (– 31 min a day). We observed that this gap in total amount of work time depended specifically on the differential in woman's bargaining power, rather than on the effect of the man's retirement.

Table 10 also shows the results of the computation of a relative measure of reallocation of domestic work, paid work, and total work (domestic plus paid work) between the woman and man in the household as an effect of the

man's retirement. For this purpose we applied the formula of Sørensen and McLanahan (1987), measuring, in this analysis, the relative contribution of each partner to housework, (man's hours–woman's hours)/(man's hours + woman's hours)%.¹¹ The resulting scores can range from – 1 to + 1, with a score of zero indicating an equal division of work. A negative value of this ratio signalled that the woman's contribution in terms of work time was higher than the man's. The opposite occurred if this index showed a positive value. We can see how the Sørensen–McLanahan index generally indicated a higher relative contribution in paid-work time by the women with lower bargaining power for couples in which the male partner was retired (– 93.9% vs. – 87.9%). Conversely, the contribution in paid-work time was higher for women with higher bargaining power, if the man was not retired (43.8% vs. 63.3%). The man's retirement produced a decrease in the woman's contribution to domestic work which was more marked for women with higher bargaining power (65.5–32.0 = 33.5) than for the woman with low bargaining power (54.2 – 27.0 = 27.2).

As seen in the computation of the Sørensen–McLanahan indexes (Table 10), the gap in the woman's relative contribution to total work between women whose partner was retired, and women whose partner was not, stood at 26–27%, with no difference for women with high bargaining power and women with low bargaining power. This implies that the reallocation of work between partners, evaluated in relative terms, penalizes the woman, whatever the level of her bargaining power.

¹¹ Brines (1994) and Gupta (2007), *inter alia*, applied the Sørensen–McLanahan index to evaluate the relative contribution of the woman to housework tasks.

Final Observations and Remarks

Our estimation results confirm what other studies have found, namely that a man's retirement does not imply a significant reduction in a woman's domestic work. These studies explain the gendered unequal division of housework between partners as a consequence of the influence of psychological and cultural factors, such as the gender attitude of partners and the higher bargaining power of the man within the couple (e.g., Ciani 2016). However, cultural factors and aspects of personality may involve an endogenous relationship between retirement decision and work time allocation in the household as a result of a bargaining process between partners. The contribution of our study is to provide a solution to the problem of selectivity effect due to the endogeneity of bargaining.

To this aim, in our analysis we jointly estimated the man's retirement equation and the woman's bargaining power equation. This approach allowed us to obtain a proxy of woman's decision power and to evaluate its impact on the man's retirement decision. Two different methods were adopted to estimate the bargaining equation (*LPM* and *GSEM-MIMIC*). Adopting a *LPM* model, we assumed the woman's satisfaction with the division of labour as a dependent variable proxy of bargaining power. Using *GSEM-MIMIC* we obtained a latent construct, based on behavioural and economic factors, as a proxy of bargaining power. In both cases, the predicted woman's bargaining power was found to be a valid predictor, positively correlated, with her male partner's propensity to retire, as it seen in the estimation of a *Probit-Retirement* equation at the second stage.

The comparison of the results of two different estimation methods shows that the *GSEM-MIMIC* procedure seemingly performed better than *LPM*. By applying *GSEM-MIMIC*, the identification of significant relationships was provided, such as the positive influence of leisure time on the woman's bargaining power. In addition, the result of the latent construct allowed us to classify women in two different groups according to their estimated bargaining power. The comparison between families in which the woman had high decision power and families in which the woman had low decision power allowed us to evaluate the effect of bargaining in labour division after the man's retirement.

The empirical relation, here analysed, between bargaining and retirement supported the hypothesis that a man from a couple where the woman has high bargaining power in household decisions is generally encouraged to leave work in order to devote more time to family commitments.

We also found that women with higher bargaining power are generally "less stressed" (they have no problems with work time management), they have better health and more leisure time than women with low bargaining power. In

addition, the time devoted to paid work by women with high bargaining power is less than the paid-work time of women with low bargaining power (Table 9). We interpret these findings to mean that women with higher bargaining power generally live in families characterized by a higher socio-economic status. In this context, it is possible that the woman, less constrained by the need to contribute to the production of income by working on the market, aims to increase her weight in terms of the responsibility of managing the home and family affairs. In short, a sort of spontaneous specialization of roles within the household occurs (such as in Bertocchi et al. 2014). However, the bargaining force of each partner is not necessarily associated with the traditional role of breadwinner, whose prevalent commitment is produced in the labour market. We think that our identification strategy of women's bargaining power is, in part, compatible with the Flinn, Todd and Zhang model (2017), in which economic dependency and personality aspects play a significant role, and, in part, is compatible with the collective approach, which uses leisure time to identify the weight of woman in decision making.

As a consequence of the higher weight of the woman in decision making, in a family characterized by a medium–high standard of living, the male partner may decide to retire early if this decision is allowed by his eligibility status, without this leading to a significant decrease in the family's standard of living due a reduction in family income.¹²

The matching procedure, adopted to compare the allocation of time between families in which the male partner is retired and families in which he is not, is here controlled for selectivity bias due to unobserved heterogeneity. We hypothesize that a relevant component of heterogeneity may be given by the misspecification of the effect of bargaining on the retirement decision. This conviction is supported by the estimation results of the man's Retirement Equation, where the estimated coefficient of bargaining is relatively high and significant (Table 6). The identification and estimation of the woman's bargaining power at the first stage allows us to control the estimation of the propensity score to retire for selectivity, and to stratify the analysis for two different levels of woman's bargaining power. Unlike the other studies regarding the identification of the general effect of retirement (see Ciani 2016), the specific aim of our study is the evaluation of the influence of bargaining on the effect of retirement. This implies that the identification of the bargaining process is a necessary step for us.

¹² Lundberg et al. (2003), for instance, found that the retirement of the primary earner (usually the husband) reduces household consumption expenditures for couples and increases the bargaining weight of the wife (usually, more engaged in household domestic work).

As a result of this analysis, the man's retirement did not lead to a significant reallocation of the woman's working hours between paid work and domestic work. The latter reduced slightly, but the gap with the man in the total time dedicated to work (penalizing for women) increased after the male partner's retirement, even though the time devoted to domestic work by the man increased.

In particular, the increase in the time devoted to domestic activities by the man was between an hour and an hour and a half a day (depending on the correction method adopted). We should take into account, however, that the time devoted to housework, according to the criterion used in our analysis, also includes gardening activities and other home-production activities, classified by analysts as "semi-leisure activities" (e.g. Stancanelli and Van Soest 2012). In a further extension of our analysis it would be interesting to separate "semi-leisure" activities from "core-housework" activities, and investigate the extent to which the male partner increases his commitment to specific core-domestic activities after his retirement.

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Dataset Used for This Research Time Use Survey 2008–2009 provided by Istat (Italian National Institute of Statistics) is available in the public domain by accessing to the link: <https://www.istat.it/it/archivio/4611>.

Compliance with Ethical Standards

Conflict of interest Maria Gabriella Campolo, Antonino Di Pino declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

Appendix

Checking Robustness of Model Estimation

In this section we report the results of a robustness check on the estimates of our model. In particular, we evaluate how the estimated relationship between bargaining process and a man's retirement decision changes if we restrict the analysis to a subsample of couples with non-working women. The comparison with non-working women allows us to verify the robustness of our estimates with respect to the endogeneity of women's retirement decisions. In Tables 11 and 12 we show the estimation results of the bargaining equation, estimated by applying the *LPM* regression alone (the *GSEM-MIMIC* procedure involves relevant convergence problems, unless several factors of the latent construct are drastically eliminated). In order to test the effect of the possible endogenous influence of the woman's decision to retire, we verified the extent to which the estimated parameters of the Retirement Equation changed as a consequence of reducing the

Table 11 Estimation results of Woman's satisfaction with housework division (LPM)

Dependent variable	Woman's satisfaction with housework division					
	Full sample		Full sample		Non-working women	
Explanatory variables	Coef	p	Coef	p	Coef	p
Intercept	0.426	***	0.466	***	0.508	**
Education of woman (years of schooling)	0.003		0.002	***	0.001	
Religiosity: 1 if the woman attends church	0.038	*	0.037	*	0.011	
Children living in the family: 1 yes	0.026		0.004		0.005	
Worried: 1 if the woman feels worried about her work	−0.1	***	−0.102	***	−0.139	**
Woman's Economic Dependency	0.022		−0.007			
Leisure time of woman	0		0		0	
Health's woman: 1 = very poor—5 = excellent	0.036	**	0.043	***	0.036	*
Man's retirement			0.071	***		
Domestic work of woman			0	***		
Domestic work of man			0	***		
AIC	4384.45		4393.19		1970.09	
BIC	4432.83		4326.67		2006.85	

AIC is the Akaike criterion; BIC is the Bayesian criterion

*p < .05; **p < .01; ***p < .001

Table 12 Estimation results of retirement equation

Explanatory variables	Non-working women		Full sample	
	Coef	p	Coef	p
Intercept	− 13.923	***	− 16.119	***
Satisfaction_ <i>LPM</i>	0.888		1.517	**
Education of woman (years of schooling)	− 0.027	*	− 0.029	***
Woman's age	0.078		0.118	
Woman's age ²	− 0.001		− 0.001	
Man's age	0.187	***	0.2	***
Area of residence: 0 = North-Centre; 1 = Southern regions ^a	− 0.252	**	− 0.294	***
Paid help received: 1 = yes ^a	− 0.113		− 0.519	***
Health's man: 1 = Sick ^a	0.216	*	0.176	*
Woman retired: 1 = yes ^a			0.457	***
Retirement Eligibility of man (<i>Eligibility</i>) = 1 if he is 58 years old, at least ^a	0.358		0.449	***
Eligibility *(Age-58)	0.253		0.114	
Eligibility *(Age-58) ²	− 0.12		− 0.089	*
Eligibility *(Age-58) ³	0.012		0.009	*

Comparison between full sample and subsample of families with non-working women

*p < .05; **p < .01; ***p < .001

Table 13 Balancing score statistics difference between treated and controls, before and after matching

Variable	Percentage of bias		Mean difference Student <i>t</i> -test	
	Before matching	After matching	Before matching	After matching
R* = Pr (Retirement)	174.7	− 35.4	45.29	− 7.68
pr_barg_sat	36.7	− 4.8	9.52	− 0.81
Woman's age	110.5	− 18.8	28.56	− 3.51
Woman's age 2	110.7	− 19	28.95	− 3.45
Man's age	159.2	− 27.8	40.02	− 6.2
Area	− 23.3	1.4	− 6.06	0.23
Woman's edu	− 39.4	8.4	− 10.27	1.42
Help recived	− 20	2	− 4.94	0.37
Man's_Health	20.6	− 2.5	5.58	− 0.42
Woman_retired	60.7	− 14.8	17.73	− 2.74
R_eligibility	155	− 34.3	38.49	− 7.06
R_eligibility *(Age-58)	122.5	− 29	34.53	− 4.79
[R_eligibility *(Age-58)] ²	97.3	− 22.6	28.58	− 3.93
[R_eligibility *(Age-58)] ³	83.6	− 18.8	25.03	− 3.43
Average of bias in %	74.91	− 15.43	20.07	− 3

sample to households with non-working women (the non-working condition excludes the possibility of choosing early retirement a priori) (Table 12).

The estimation results reported in Table 12 confirm that the sample restriction to couples with non-working women does not lead to relevant modifications in the sign and level of coefficients of covariates explaining the male partner's retirement decision. Note, however, that the bargaining correction coefficient is not significant if we impose the sample restriction. Applying matching procedure and computing

ATT parameters, we found that the domestic work of non-working women decreased by 38.5 ($SE = 11.42$) minutes a day (− 38.51), while men's domestic work increased by 77.2 ($SE = 9.80$) minutes a day. Compared to the results reported above in Table 8 for the full sample, the reduction of the woman's domestic work, consequent to the man's retirement, was found to be higher for non-working women. May this difference imply that the woman's decision on whether or not to retire ended up mitigating or exacerbating the effect of the man's retirement? A convincing answer to this question

Table 14 Category of low women’s bargaining power: balancing score statistics—difference between treated and controls, before and after matching

Variable	Percentage of bias		Mean difference Student <i>t</i> -test	
	Before matching	After matching	Before matching	After matching
R* = Pr(Retirement)	157.7	− 38.8	22.4	− 4.39
pr_barg_sat	33.8	19.3	4.65	1.75
Woman’s age	99.2	− 16.9	13.77	− 1.79
Woman’s age ²	100.1	− 16.8	14.04	− 1.76
Man’s age	156.6	− 23.1	20.88	− 2.78
Area	− 15.5	4.9	− 2.14	0.46
Woman’s edu	− 30.5	22.7	− 4.26	2.13
Help recived	− 15.6	6.7	− 2.05	0.7
Man’s_Health	16.3	− 7.1	2.34	− 0.64
Woman_retired	43.1	− 23.4	6.98	− 2.26
R_eligibility	147.1	− 36.9	19.6	− 4.18
R_eligibility *(Age-58)	116.3	− 20.4	18.43	− 1.82
[R_eligibility *(Age-58)]^2	91.3	− 15.1	15.34	− 1.4
[R_eligibility *(Age-58)]^3	78.1	− 12.5	13.5	− 1.24
Average of bias in %	69.86	− 11.24	10.25	− 1.23

Table 15 Category of high women’s bargaining power: Balancing score statistics—difference between treated and controls, before and after matching

Variable	Percentage of bias		Mean difference Student <i>t</i> -test	
	Before matching	After matching	Before matching	After matching
R* = Pr (Retirement)	178.6	− 33.1	38.47	− 6.16
pr_barg_sat	32.2	2.2	7.14	0.3
Woman’s age	112.3	− 23.8	24.33	− 3.7
Woman’s age ²	112.2	− 24.1	24.56	− 3.61
Man’s age	157.9	− 29.7	33.5	− 5.57
Area	− 26.9	0.1	− 5.89	0.01
Woman’s edu	− 40	2.6	− 8.75	0.36
Help recived	− 21	0.8	− 4.37	0.12
Man’s_Health	24.3	− 2.5	5.5	− 0.35
Woman_retired	65.7	− 10.2	15.72	− 1.56
R_eligibility	156	− 32.6	32.65	− 5.56
R_eligibility *(Age-58)	123	− 32.6	28.49	− 4.53
[R_eligibility *(Age-58)]^2	98.2	− 25.8	23.5	− 3.78
[R_eligibility *(Age-58)]^3	84.6	− 21.3	20.54	− 3.3
Average of bias in %	75.51	− 16.43	16.81	− 2.67

requires a more detailed investigation which, for reasons of space, cannot be carried out here.

Finally, proper balancing statistics are provided to test the extent to which the matching procedure reduces differences in covariate distribution among families which experienced the retirement of the male partner and those which did not. (Tables 13, 14, 15).

Balancing Test Statistics on Matching

After performing the simple matching procedure, we checked the covariates conditioning the propensity score by testing the balance between treated and untreated cases before and after

matching. In order to quantify the bias between the two sample units, we used the Absolute Standardized Difference in Covariate Means (Haviland et al. 2007), as a standardized mean difference between treatment and control units. The bias (as a percentage) was computed by dividing the absolute difference in means of the covariate between the treated group and the control group by the overall standard deviation, as shown by the following formula:

$$BIAS = \frac{|\bar{x}_T - \bar{x}_C| * 100}{S_x} \tag{7}$$

where the denominator is the overall standard deviation

$$S_X = \sqrt{\frac{S_T^2 + S_C^2}{2}}$$

The statistics (7) of BIAS in balancing, computed before and after matching, are presented in Tables 13, 14 and 15. In particular, we show the statistics regarding the matching procedures applied to the full sample, and separately, to the subsamples of women, respectively, with lower and higher bargaining power.

The second and the third columns of Tables 13, 14 and 15 contain the standardized bias of propensity scores and covariates, before and after matching, computed following formula (7). The fourth and the fifth columns show, for each covariate, the Student-*t* statistics computed on the difference of means between treated and untreated, before and after matching. In general, we found that balancing score statistics perform better when we consider the subsample of women with high bargaining power.

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