Investment in Household Public Goods and Divorce

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Abstract

This article studies the interaction between divorce and spouses' investments in household public goods. I develop a two period model with imperfect information where the decision of divorce is endogenously determined by intra-household investments. The model predicts that insufficient contributions to the production of household public goods lead to marital dissolution. A further implication of the model is that quality of investments is essential for the divorce decision. The predictions of the model are supported by the empirical analysis conducted using the Children Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID). Children represent the household public good while time that parents spend with their children, the investments. I find that the hazard of separation decreases with paternal time and in particular with high quality time. Finally, a closer look at the nature of parental time highlights lower hazard of divorce in families with weaker gender roles.

JEL Classification: D13, D82, J12, J13

Keywords: Marital dissolution, household production, time use, signalling games, survival analysis

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1 Introduction

This paper aims at a better understanding of family behaviour and divorce. On the one hand, I complement the existent divorce theory proposing a dynamic model where the decision of divorce is directly influenced by marital specific investments. On the other hand, I study the behaviour of couples with children using a subsample of the Panel Study of Income Dynamics (PSID), focusing on the relationship between the hazard of divorce and time spent in household public goods.

The economic rationality behind marriage is the creation of a household public good, whose quality is determined by spouses investments. In the empirical analysis, children represent the household public good produced whilst parental time, investments towards that production. Children are the household public good of focus for two essential reasons. First, there exists consensus in the literature that family disruptions have detrimental effects on children outcomes and well-being. [1] Second, economic models of human capital formation (Leibowtiz, 1974; Coleman, 1988) and numerous empirical studies, discussed in the next section, highlight the importance of parental investments in future children's outcomes.

The central finding of both the theoretical and empirical analysis is the existence of a strong link between low investments in household public goods and the decision of divorce. On the one hand, spouses with a high concern for household public goods use divorce as a credible threat and as an incentive to increase marital specific investments of their partners. On the other hand, hold up arises in the family context: the option of divorce rises the concern of an ex-post expropriation of marital specific investment by the other partner. [2] A further implication of this first finding is that the repercussion of underinvestment in children is twofold, on divorce and on next generation of citizens.

I propose a simple two period model of intra-household investments with imperfect information, signalling game, were spouses behave non-cooperatively. One spouse (mother) has imperfect information on the preferences of the other spouse (father) and updates her beliefs observing the time he spends in the public good in a first period. Divorce is not dependent on an exogenous shock but on spouses' investments. The novelty of the simple model proposed relies on the combination of three main features. First, divorce is determined endogenously as a consequence of spouses' investments in a household public good. Second, efficiency does not arise in equilibrium. Third, the outcomes here obtained are self-enforced.

I use data on PSID families that take part in the Child Development Supplement (CDS). Specifically, I analyse the behaviour of couples that were married in 1997 with biological children aged 12 or under. I examine changes in their marital status for 10 years, from 1997 to 2007, conditional on spouses' characteristics and parental time. Contrary to most empirical studies I extract a direct

[1] See Aiyagari et al. (2000) or Chiappori and Weiss (2006; 2007) as examples of theroretical studies focusing on the effect of divorce on children and Francesconi et al. (2010), Manski et al. (1992), Amato (2010) for an empirical perspective.

[2] Francesconi and Muthoo (2005) claim that given that mothers usually obtain children's custody's, paternal time within marriage could be understood as a sank investment.

measure of parental time since the CDS collects time diaries of children. [3] It hence permits the analysis of time that each children devotes to different activities and who they conduct the activity with.

The main implication of the model is that fathers that spend low relative time with their children face divorce, where relative time refers to the proportion of time that parents devote to their children when they are not at work. Examining the PSID-CDS data, I show that the hazard of divorce significantly decreases with relative paternal time. According to the model, marital instability is dependent on the quality of public good investments: high quality investments have a considerably higher effect on deterring divorce than low quality investments. In this lines, the data suggests that it is time that fathers participate with their children in an activity (high quality time) that affects the decision of divorce. Whilst time that fathers are present but not involved in the activity (low quality time) do not appear to have any significant effect. [4]

Once established that parental time affects the divorce decision, I classify parental time in four different categories, according to the activity conducted, to explore which type of time has a higher effect. I consider both the effect of time that the family spends together and the effect of time that one of the parents alone devotes to their children. The main conclusion reached is that the higher the contribution of the whole family to activities traditionally carried out by mothers (household tasks) and degree of settlement of the family (and specially the mother) in the society and in their children social environment decreases the hazard of divorce.

In the next section I conduct a summary of a selected number of papers dealing first with divorce and then the nature and effects of parental time, that it is by no means a complete literature review.

2 Existing Literature

2.0.1 On divorce

Becker, Landes and Michael (1977) constitutes the basis for a theoretical approach and subsequent empirical analysis of the causes of divorce. A search model with uncertainty where gains from marriage come from spouses' marital specific investments, mainly children, is proposed. The main implications of the model are tested using the Survey of Economic Opportunity (SEO) and the Terman Survey. Weiss and Willis (1997) extend the previous analysis by disentangling how unexpected income affects marital dissolution using the NLSY72 dataset. Among the multiple findings, their model predicts that the existence of marital-specific capital reduces the probability of dissolution, although it is not empirically tested. In addition, the basic determinants of divorce included in the empirical study are based on the previously described papers, however the focus of this paper is

[3] Blau et al. (1992), Baum (2003), Bernal and Keane (2011), Ruhm (2004) or Ermisch and Francesconi (2001) use employment or paternal leave to measure parental time.

[4] Weiss and Willis (1997) find that having children and specially younger children as well as owing properties stabilises the marriage.

to analyse those marital specific investments through the inclusion of time spent in public goods. Several studies propose alternative models of divorce. As an illustration, Aiyagari et al. (2000) or Chiappori and Weiss (2006, 2007) focus on the consequences of divorce. The former finds that divorce leads to lower parental human capital investment while the later that higher divorce rates lead to lower detrimental welfare effects of divorce, specially on children. Rasul (2006) or Clark(1999) propose different theoretical models to analyse the effects of divorce legislations on divorce rates. On the one hand, Rasul(2006) finds that unilateral divorce laws increase divorce among couples that were married at the time the law was passed although it also predicts a lower steady state level of divorce considering that the couples that remain married would be better matched. On the other hand, Clark (1999) analyses the interaction between property and divorce laws and shows how different combinations of divorce laws and property laws give rise to different divorce rates.

Marital instability has been widely studied in empirical grounds. From its determinants, analysed in the previously mentioned Becker et al. (1977) or Weiss and Willis (1997), to the reasons of the increase in divorce rates in the US and Europe (Wolfers (2006), Gonzalez and Viitanen (2009), Stevensons and Wolfers (2007)) or the effects of divorce legislation on divorce rates (Friedberg (1998), Wolfers (2006), Gruber (2004)). Moreover, the effects of divorce on children has capture the attention of numerous scholars. Amato and Keith (1991), Amato(2001) and Amato(2010) reviewed the the existent literature in sociology, psicology and social studies reaching three main conclusions. First, divorce was observed to have a negative (although weak) effect on the well being of children. Second, the effect of divorce in children in the 90s is stronger than in those experiencing parental divorce in the 80s. Third, divorce lowers the overall score of children. Francesconi et al. (2010), for example, concludes that divorce has a negative effect on children educational attainments in Germany while Manski et al. (1992) analyse the effect of family structure on children outcomes and conclude that children of intact families have a higher probability of graduating. It is hence sensible to focus on children as being the main household public good produced within a family given the observed detrimental effects that empirical studies have found that divorce has on them.

Different theoretical models have been proposed to explain the detrimental effects of divorce on children. Weiss and Willis (1985) propose a model of divorce settlements where parental investments after divorce are analysed under the assumptions of both efficient and inefficient outcomes. Mothers are assumed to obtain children's custody and fathers underinvest in their children due to their incapability to control maternal usage of that investment. A test of the model is conducted in Weiss and Willis (1993) using the NLSY72. Divorce laws, duration of marriage, number of children or ex-ante expected income increases settlements. The highest transfer to the child is observed in the ex-ante efficient framework. Conversely, lower paternal investment during marriage is found to be the source of detrimental effects of divorce on children in the model described in next section. The model is supported by the findings of the survival analysis conducted using the PSID-CDS sample of married couples with biological children. Furthermore, Cherlin et al. (1998), Sun and Li (2001, 2002) empirically observe that the negative outcomes for children are observed previous to

divorce. This finding is in line with the findings that families that invest less in the household public good get divorced. In the next section a review of parental time literature is conducted and shown that parental time do affect children outcomes, specially in their first years. Finally, Schmierer (2010) proposed an empirical and theoretical analysis that suggests that parents, in anticipation of divorce, spend less time with their children. A three period model of divorce is proposed and tested using both the PSID-CDS and NLSY79 datasets. Although the backward induction solving procedure of dynamic models might lead to that interpretation, it is believed here that such an inverse causality does not apply to reality.

2.0.2 On Parental Time

According to both sociologist and economists parental time is an essential input in the production function of human capital, see Leibowtiz (1974) or Coleman(1988), so that it drives the attention of numerous scholars. The amount and distribution of parental time has varied considerably in the past decades mainly due to the incorporation of women to the labour market: women's participation in the labour market alter the distribution of time devoted to children within and outside the family, replacing maternal child-care by other forms of child-care (institutional or informal). There are important studies suggesting that maternal employment during the first years of children's life are observed to have a detrimental effect on children cognitive abilities (Blau et al., 1992; Baum, 2003; Bernal and Keane, 2011; Ruhm, 2004; Ermisch and Francesconi, 2010). Maternity leave opportunities are also widely studied: Carneiro et al. (2010) study the effect of a reform that increased the duration of maternity leave in Norway and concludes that children of mothers with higher maternal leave have a significantly lower high school drop out rate; while Rasmussen (2010) does not observe any significant effect of an increase in available parental leave weeks on children's outcomes in Denmark. In addition, Hallberg (2003) suggests that policies aiming to increase time that parents spend with their children should target at paternal time: a change in paternal working hours is observed to have a greater influence on parental time than a change in maternal working hours. Finally, non-cognitive skills are highly affected by quantity and quality of time that parents spend with their children according to Heckman (2000). Hence, parental time is an essential form of parental investment due to its importance in developing children's cognitive and non-cognitive skills.

However, it is important to highlight that the above described studies do not have direct information on parental time: home scores, employment information or parental leave status are used as proxies. A main reason for their approach is small sample sizes of time use surveys and absence of detailed background variables. Analysing time use surveys, Hofferth and Sandberg (2001, 2005), Bianchi (2000) and Bianchi et al.(2004) conclude that the overall time devoted to children has not decreased during the past decade. Guryan et al. (2008) makes use of diverse countries time surveys to analyse child care and its determinants reaching the same conclusion as Sayer et al.(2004): more educated parents spend more time with their children. Rasmussen (2009) concludes that maternal

time during weekends and paternal time during weekdays have a positive effect on children high school enrolment in Denmark. The main difference among the previous time-use studies and my approach is that we use children time-diaries instead of parents time diaries. Folbre et al. (2005) Folbre and Yoon (2007), Yeung et al. (2001) or the above mentioned Schimerer (2010) are among the studies employing this dataset. While the definitions of childcare used here follows Folbre et al. (2005), separated analysis are conducted for both weekend and week days as in Yeung (2001) and Rasmussen (2009).

Divorce and time use literature confirm that on the one hand, divorce has a negative effect on children's outcomes and, on the other hand, parental time affects children's non-cognitive and cognitive skills. The importance of children outcomes in future societies and the relevance of parental time among the different parental investments drives the decision of treating children as the household public good and parental time as the main investments in that household public good.

3 A Model of Intra-Household Investments

3.1 Set Up

Two individuals, wife and husband, live for two periods and form a family in the first period.[5] In each period they obtain utility from leisure, l, and the size of the public good created within the household, G, that represents children's well being. Each spouse is endowed with a fixed amount of available time, t_w for the wife and t_h for the husband, which they can either spend on leisure, l, or with their children, g. Each individual hence faces the following time constraint

$$t_i = l_i + g_i \quad \text{for } i = w, h \tag{1}$$

Spouses' investments in the public good are assumed to be perfect substitutes so that the total public good created is simply the sum of their individual investments, $G = g_w + g_h$. I focus the analysis on the "weekend" as I do not model parents' labour supply decisions. Spouses' available time during the weekend is similar and due to the generally higher involvement of the wife on household tasks, I assume that her time available is lower or equal to the time available of the husband, $t_w \leq t_h$. [6] I normalise the time of the husband to 1 and therefore restrict the relative time of the wife to be lower or equal, $0 \leq t_w \leq 1$.

Individual preferences are represented by the Cobb Douglas utility function,

$$U_i = l_i^{\theta} G^{1-\theta} \quad \text{for } i = w, h$$

where $\theta \, \epsilon \, [0, 1)$ represents the preference for leisure: the lower the θ, the higher the preference for the public good. Therefore, $U(l_i, G)$ is an increasing and concave utility function in each of the

[5] The members of the couple are named wife and husband for identification purposes. However, it does not imply the analysis to be focused on heterosexual couples, it can perfectly be applied to homosexual couples.

[6] According to Bianchi et al. (2012), husbands of married American couples with children spend on household tasks one third of the time that the wife spends on average.

arguments with $U(0, G) = U(l_i, 0) = 0$.

There are two type of husbands in the society: $\theta = 0$, caring type (high type) and $\theta = \frac{1}{2}$, careless type (low type) and one type of wife $\theta = \alpha$. The preferences of the wife are known, but those of the husband are known just by him. I assume that the low type husband has a lower preference for the public good than the wife so that $\alpha < \frac{1}{2}$.[7] The decision variables in my model are the amount of time spent with children and in leisure in each period and the model developed is a signalling game.

The timing of the game is as follows. Nature moves and chooses the type of husband, $\theta = 0$ with probability p and $\theta = \frac{1}{2}$ with probability $1 - p$. In the *first period*, the husband observes his type, θ, and chooses time spent with children, i.e. $G^1 = g_h^1 \epsilon [0, 1]$.[8] In the *second period*, the wife observes the investment of the husband, updates her beliefs and decides whether to divorce him or to carry on with the marriage.

If the couple remains married, both spouses non-cooperatively and simultaneously decide the share of their time to spend in the public good $G(g_w, g_h^2, g_h^1, \lambda)$. This choice depends on the time of their partner, the public good produced in the first period and the exogenous parameter, λ, that symbolises the quality of the investment in the first period. I restrict he values of λ between 0 and 1.

If the couple divorces, both spouses remarry in the second period and loose the investment of the first. In the second marriage each spouse maximises its own utility and non-cooperatively determines the time to devote to the public good, $G(g_w^2, g_h^2)$. [9] The distribution of husband's types in the remarriage market is exogenous and assumed to be equal to the prior beliefs of the wife in the first period. Threfore, p does also represent the probability that a wife remarries a caring husband and is assumed to be $\frac{1}{2}$. [10]

Figure 1 represents the signalling game played by the spouses where N denotes the decision node of Nature i.e choosing the type of husband; H is the decision node of a high type or caring husband; L is the decision node of a low type or careless husband; and W represents the decision node of the wife. If the wife observes an investment of g_h^1 in the first period, she believes that with probability μ she is married with a high type and with probability $1 - \mu$, with a low type. If she observes an investment of g_l^1, she believes that her partner is a low type with probability π and a high type with probability $1 - \pi$.

For simplicity, I concentrate on pure strategies where a pure strategy for the wife must specify one of the two responses, either M (continue the marriage) or D (divorce), and her investment in

[7] Specific values of the preference parameters does not affect the qualitative results.

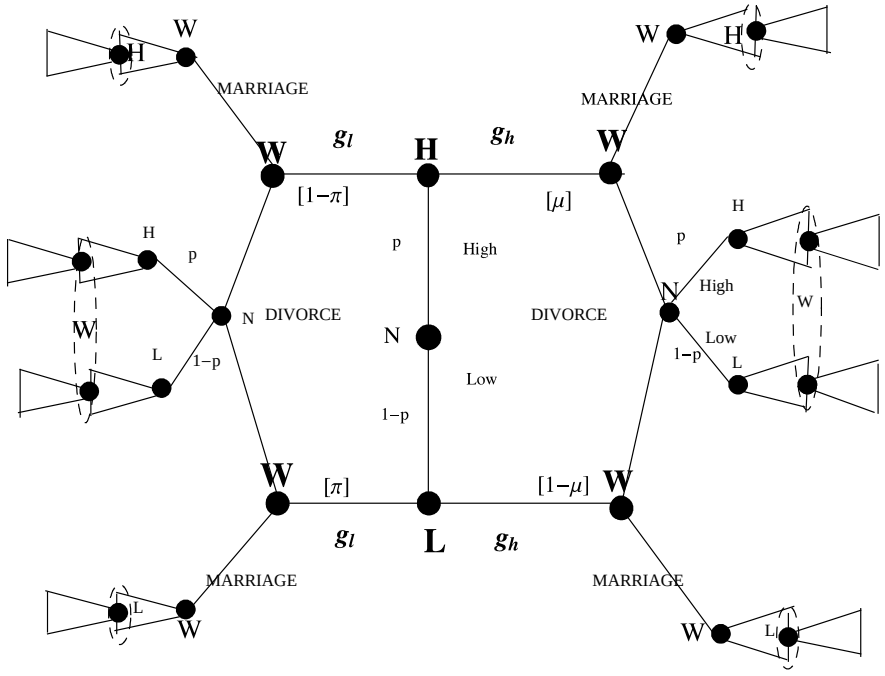
[8] During the first years of a children's life, mothers are constrained to spend all their time taking care of them regardless of their partners decisions or future investments. Assuming that the husband is the sole investor in the first period leads to similar conclusions than assuming a constant investment of the wife in the first period.

[9] The lost in investments captures the detrimental effects that divorce has on children outcomes (Amato, 2010).

[10] As there is a continuous flow of new entrants in the remarriage market, divorce would always arise as long as there is a positive probability of remarrying a caring husband. Therefore, assuming $p = \frac{1}{2}$ simplifies the problem but the qualitative results would also hold with a $0 < p < \frac{1}{2}$.

the public good in both states, for each first period investments of the husband. Therefore, a pure strategy for the wife is $\psi_w = (\sigma(g^1), g_w^2)$ where $\sigma(g^1)\epsilon\{D, M\}$ for each first period investment (g^1). A pure strategy for the husband must specify the investment in the public good in the first and second period condition on each type of husband, where the action of the second period is contingent to the decision of marriage or divorce of the wife, $\psi_l\Big(g_l^1, g_l^2\big(\sigma(g^1)\big)\Big)$ and $\psi_h\Big(g_h^1, g_h^2\big(\sigma(g^1)\big)\Big)$.

Figure 1: Signalling Game



3.2 Equilibrium Concepts

The Perfect Bayesian Equilibria (PBE) of the above signalling game,

Definition 1. Perfect Bayesian Equilibrium[11]

An assessment $\big(\psi_l(.), \psi_h(.), \psi_w(.)\big)$ *is a pure strategy PBE of the divorce signalling game if*

(i) Given the strategy of the wife, ψ_w*, the strategy* ψ_l *maximises the low type husband expected utility and* ψ_h *the high type expected utility.*

(ii) for every g^1*, the wife reaction* $\psi_w(.)$*, maximises her expected profits given her beliefs*

(iii) the wife's beliefs satisfies Bayes' rule, whenever possible

[11]Note that the Perfect Bayesian Equilibria are the same as the sequential Equilibria in signalling games

Conditions (1) and (3) ensure that the assessment is sequentially rational whereas condtion (2) ensures that the wife's beliefs are consistent with Bayes' rule. If the different types choose different investments in the first period, then by observing g_l^1 she infers that she faces the low type husband while if she observes g_h^1 the wife infers that she faces a high type husband. If, on the other hand , the two types choose the same investment in the first period, then, the wife's beliefs remain unchanged and equal to her prior beliefs. The off Equilibrium beliefs are restricted using the Cho and Kreps Intuitive Criterion.

Definition 2. An Intuitive Criterion *A PBE yielding equilibrium utilities u_l^* to the low type husband and u_h^* to the high type, satisfies the intuitive criterion if the following condition is satisfied for every first period public good investment $g^1 \neq g_l^1$ or g_h^1:*

If $u_i(g^1) > u_i^*$ and $u_j(g^1) < u_j^*$ the $\beta(g^1)$ places probability one on risk type i, so that

$$\mu(g^1) = \begin{cases} 1 & \text{if } \ i = h \\ 0 & \text{if } \ i = l \end{cases}$$

Therefore, the Intuitive Criterion places no restrictions on the beliefs of the strategies that are not equilibrium dominated or strategies that are equilibrium dominated for both spouses.

4 Analysis

The PBE of the game are obtained solving the game by backward induction. In *Section 4.1*, I find the Nash equilibrium of the marriage and remarriage games in the second period. In *Section 4.2*, I analyse the divorce decision of the wife. And in *Section 4.3*, I characterise the decision of the husband in the first period, that chooses the investment that maximises his life-time utility function subject to the threat of divorce.

4.1 Second Period: Nash Solution of Marriage and Remarriage

In this section, I characterise the investment choices of the spouses in the second period according to the previous divorce decision of the wife. Because understanding the intra-household behaviour leading to divorce is the main target of this research, the analysis mainly focuses on the strategies driving it. A first result restricts the strategies leading to a marital disruption by finding that divorce does never arise if the wife cannot perfectly identify the type of husband she is married to: divorce does not arise in a pooling equilibrium.

Proposition 1. *In a pure strategies pooling equilibrium the wife does never get divorced.*

Proof. In the second period, the utility of the wife if she keeps the marriage and does not distinguish the type of her husband is always higher than the utility of getting divorced and facing the risk of remarrying a low type husband. See Appendix E

Consequently, I focus on the separating equilibria, where different types of player choose different actions in the first period so that the wife can perfectly identify them. If the wife chooses to keep the marriage each spouse maximise the following utility function in the second period:

$$\max_{1\geq g_i^2\geq 0} \qquad U_i^{2m} = (t_i^2 - g_i^2)^{\theta}(g_i^2 + g_j^2 + \lambda g_h^1)^{(1-\theta)} \quad \text{for i, j = w, h} \tag{2}$$

If the wife decides to get divorced, each spouse remarriages and in the second period maximises the following expected utility function:

$$\max_{1\geq g_i^2\geq 0} \qquad E[U_i^{2d}] = E[(t_i^2 - g_i^2)^{\theta}(g_i^2 + g_j^2)^{(1-\theta)}] \quad \text{for i, j = w, h} \tag{3}$$

Individual i's investment enters the utility function of the spouse, j, so that public good investments depend on the expectations of the investments of the partner. An individual hence maximises its second period utility, taking the investment of the other spouse as given.

Figure 2 and Figure 3 illustrate the reaction functions and Nash solutions of the marriage and remarriage game. The nature of the solution, corner or interior, depends on the preference of the wife for the public good, $1-\alpha$, and her relative time available over the "weekend", t_w. Moreover, the investment of the husband in the first period is also a determinant of the nature of the solution in the marriage game. Solution I in Figures 2 and 3 is an interior solution, at solution W the wife does not invest in the public good and at H, it is the husband that does not have time for his children. In either the separating equilibrium with a caring husband or the remarriage game, solution H, where the husband does not invest in the public good, does not occur.

Each type of solution represent a certain class of family. According to Esping-Andersen's (2009) taxonomy of the family, nowadays three types of families coexist in the society: Beckerian family, gender equality family and unstable family. A *Beckerian family* is a nuclear family where the male is the bread-winner and the female the home-maker. Therefore, the role of the husband is to work and provide income to the household, while the wife devotes her time to her children and household duties. The wife is economically dependent of her husband. These families are characterised by early marriage, high fertily and low divorce rate. A *gender equality family* arises with the incorporation of the women to the labour market. The women of these families gained economic autonomy and there are no gender roles within the family. These families tend to have children although probably less than preferred due to the high amount of time devoted to their work. An *unstable family* represents an inadequate maturation of the gender-equality family. Low income, uneducated families without common values or life targets fall in this type. Family values as well as their beliefs and preferences are not clear. Suboptimal outcomes are associated to this type of families and divorce is common.

In Figure 2, the family at solution I of the caring husband graph is a gender-equality family with caring spouses where both spouses collaborate in housework and have similar and high preferences towards the public good. Beckerian families appear at equilibrium W of both the careless and caring

Figure 2: Marriage Game

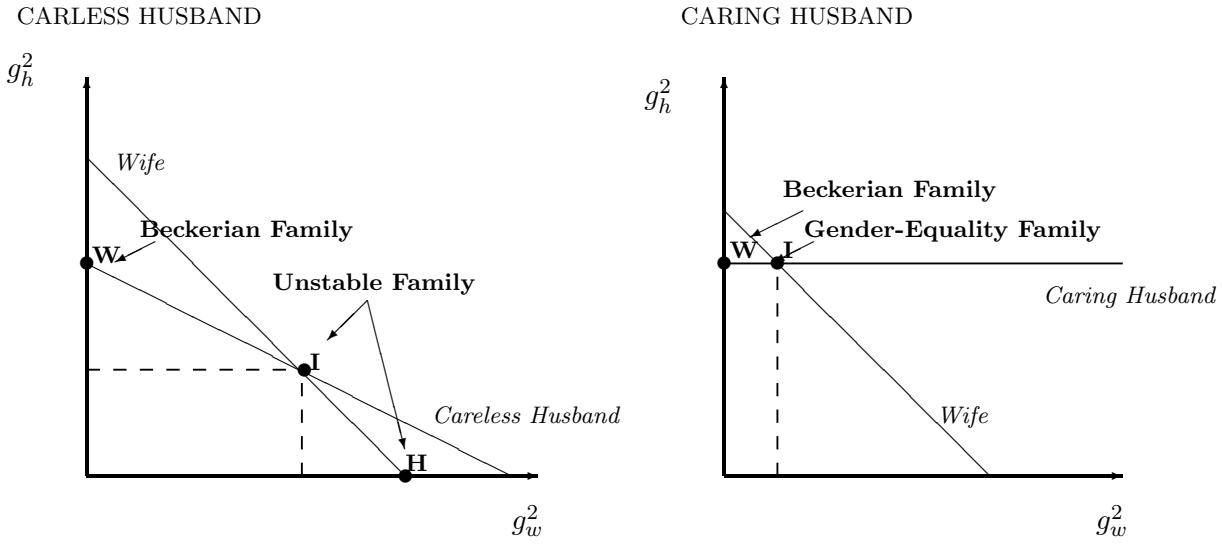
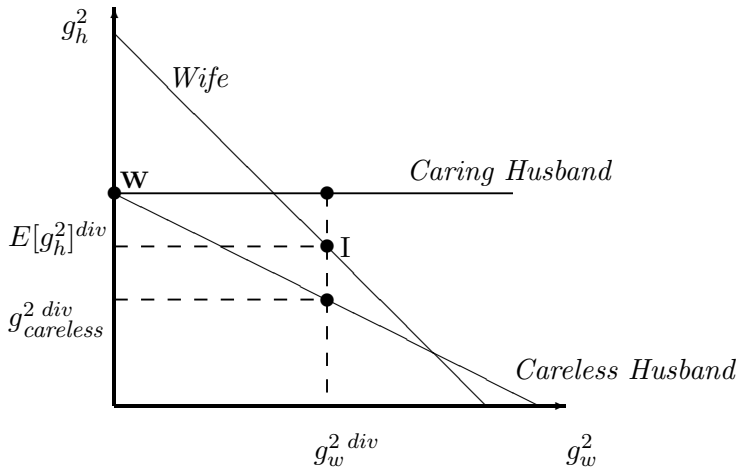


Figure 3: Remarriage Game



husband graphs.[12] Solutions I or H in the careless husband graph depict the behaviour of unstable families.

The properties of the Nash equilibrium of the marriage game with caring or careless husbands and of the remarriage game differ between the corner and interior solutions described next.

Proposition 2. *In the Nash equilibrium of the second period,*

(i) at an interior solution, an increase in the relative time available (t_w) or preferences for the public good ($1-\alpha$) of the wife decreases the proportion of public good created by the careless husband and increases the proportion created by the wife in marriage and remarriage

(ii) at a wife corner solution, an increase in the relative time available or preferences for the public good of the wife does not affect the distribution of public good production in marriage and remarriage

(iii) at a careless husband corner solution, an increase in the relative time available or preferences for the public good of the wife increases the proportion of the public good created by the wife in marriage

(iv) an increase in the amount or quality of first period investments decreases the proportion of public good created in the second period in marriage.

Unlike Becker's model, the model of family behaviour here proposed takes into account that different household allocations might have different household consumption or investment patterns. An expected redistribution of time available among spouses does not affect the equilibrium outcomes whenever the solution is interior, however, it does affect it whenever one of the spouses does not invest in the public good in the second period. These results are common in static environments of this type of settings where spouses' endowment is income (see Chen and Wolley, 2001), and suggests that it is only whenever the difference in incomes is considerably high, that the distribution of incomes within the family affects the consumption decision. In this setting, time redistribution has no influence on the equilibrium outcome if time and preferences of the spouses are similar. By increasing the relative time of the wife the proportion of public good that she produces increases and the proportion produced by the careless husband decreases (Proposition 2(i)) but unless the overall family time is affected the public good produced remains unchanged.

Proposition 2 (i) and Proposition 2 (iv) follow from the observation that the contributions to the public good in the first and second periods are substitutes so that free riding is always present. Therefore, the higher first period investments are, the lower the proportion invested by the careless type and wife in the second period. At an interior solution, an increase in the preferences of the wife towards the public good increases her proportion of public good created and decreases the proportion of public good created by the low type. Nevertheless, at a corner solution it is just time

[12] In Figure 2, solution W could also refer to couples where the wife is careless.

and preferences of the spouse that invests in the public good that affects the equilibrium choices, in both marriage and divorce. Finally, the amount and quality of the investment in the first period decreases the proportion of time devoted to the public good in the second period in marriage in both interior and corner solutions.

4.2 Divorce Constraints

The wife decides to get divorced if, after observing the investment of the husband in the first period, she expects a higher utility in the remarriage than in the marriage game in the second period.

If the husband is caring, the utility of the wife in the second period is always higher if the marriage continues so she does not get divorced. Recall that in the remarriage market there are the same proportion of caring and careless husbands. Consequently, in the event of divorce, not only first period investment is lost but she incurs in the risk of matching with a low type husband i.e she would remarry a low type husband with probability $\frac{1}{2}$.

Proposition 3. *In a separating equilibrium, the wife does never divorce if the husband is caring.*

Proof. See in Appendix C that in the second period the utility that the wife obtains from remarriage is always lower than the utility of marriage with a caring husband.

If the wife identifies that she is married with a careless type husband, she imposes a lower bound investment to his expenditure in the public good in the first period that needs to be satisfied if the husband is willing to continue with the marriage. This divorce constraint ensures that the utility of the wife in the second period if she keeps the marriage is at least equal to the utility of getting divorced.

4.3 First Period: Separating Equilibrium

4.3.1 Caring Husband

In a separating equilibrium, a caring husband spends all his time with his children and due to Proposition 3 the wife does never get divorced. As his marginal utility of investing in the public good is always positive, he invests at the maximum, that is all his weekend time, $t_h = 1$, in both periods.

Proposition 4. *In a Pure Strategies Separating Equilibrium, a caring husband invests all his income in the public good in both periods,* $g_h^1 = g_h^2 = 1$.

4.3.2 Careless Husband

In this section, I characterise the separating equilibrium when the husband is careless. In the first period the husband chooses the investment in the public good that maximises the following life time

utility function:

$$\max_{1\geq g_h^1\geq 0} \quad U_h^1(g_h^1, \lambda, t_w, \alpha) + \delta U_h^2(g_h^1, \lambda, t_w, \alpha) \tag{4}$$

subject to the Nash equilibrium actions of wife and husband constituting either interior or corner solutions in the second period and subject to a divorce constraint if the path chosen by the wife in the second period is marriage. Given that the life time utility function of the husband is concave, a maximum exists and is unique so that a unique PBE in pure strategies arises.[13]

If the careless husband fails to satisfy the divorce constraint of the wife, he faces the remarriage game in the second period. If this is the case, in the first period the careless husband maximises his lifetime utility by investing half of his time available in the first period, $g_{d_l}^1 = \frac{1}{2}$. [14] By comparing the choice of the husband in the first period if divorce occurs with probability 1 and that of the divorce constraint, I can conclude that a binding divorce constraint forces the careless husband to overinvest in the first period to avoid divorce. Consequently, the existence of a divorce threat raises the investment of the husband in the first period and assures that it is at least equal to the investment of divorce, $\frac{1}{2}$.

Proposition 5. *In the PBE, the minimum investment that the husband has to do in the first period to keep the marriage is always higher or equal to* $\frac{1}{2}$*, the investment that the husband would do in the first period if divorce occurs with probability 1.*

Proof. See in Appendix B that the divorce constraint, that is the lowest possible investment in marriage is always at least equal to $\frac{1}{2}$.

The investment in children in the time preceding divorce is hence lower if spouses eventually end their marriage than if they carry on with it. This finding gives support to the theory of the hold-up problem in the family (Francesconi and Muthoo (2003; 2010)) and is consistent with Cherlin et al. (1998) or Sun and Li (2001, 2002) that conclude that the effects of marital instability on children are present previous to divorce.

Analysing the PBE, the quality of the investment appears to be an essential determinant of the divorce decision:

Proposition 6. *If divorce is the PBE at* λ *then either divorce also occurs* $\forall\lambda'$ *or* $\exists\, \tilde{\lambda} > \lambda : \lambda > \tilde{\lambda}$ *divorce does not occur.*

Proof. See Appendix C.2.

Not every type of time has the same effect on the decision of divorce and the more productive the time is, the lower the "likelihood" of divorce. More specifically, the divorce constraint is never

[13] See the appendix C.2

[14] See proof in Appendix C.1

satisfied if the proportion of the public good of the first period that remains for usage in the second is low. There exists a value of λ under which divorce is always the PBE of the signalling game. If $\lambda \leq \frac{1}{2}$, the husband does not satisfy the divorce constraint as the wife demands a first period investment that exceeds his time available.[15] Empirical evidence is highly supportive with this result when considering a broader notion of public goods. For instance, Weiss and Willis (1997) find that having children and specially younger children as well as owing properties stabilises the marriage.

The features of the solution in the second period, corner or interior, shape the divorce constraint and the properties of the Perfect Bayesian Equilibrium. Proposition 7 presents the main characteristics of the equilibrium while Appendix C shows the procedure followed in order to solve the signalling game.

Proposition 7. *In a Pure Strategies Separating Equilibrium, a careless husband*

(i) of a Beckerian family (wife corner solution in the second period), does not face divorce and the quality of the investment determines the between periods distribution of investments

(ii) of an Unstable family,

(a) at an interior solution in the second period,

- *If divorce is the PBE at t_w then either divorce also occurs $\forall t'_w$ or $\exists\, \tilde{t_w} > t_w : t_w > \tilde{t_w}$ divorce does not occur*
- *If divorce is the PBE at $(1-\alpha)$ then either divorce also occurs $\forall (1-\alpha)'$ or $\exists\, (1-\alpha)'' > (1-\alpha) : (1-\alpha) > (1-\alpha)''$ divorce does not occur*

(b) at a husband corner solution in the second period, If divorce is the PBE at α then either divorce also occurs $\forall \alpha'$ or $\exists\, \tilde{\alpha} > \alpha : \alpha > \tilde{\alpha}$ divorce does not occur

Proof. See Appendix C.2.[16]

In a *Beckerian family* where the husband is careless, the wife has such a low combination of relative time and preferences for the public good (where $\frac{1-\alpha}{\alpha} t_w < \frac{3}{4}$) that she does not spend time with her children in the second period and divorce is not the PBE.[17]

In *Unstable families* where both spouses invest in the public good in the second period, divorce increases with relative time and preference towards the public good of the wife. On the one hand, the higher the relative time and preferences of the wife for the public good the higher the odds of binding of the divorce constraint. On the other hand, if the divorce constraint binds, the utility of the husband of getting divorced becomes relatively higher than the utility of keeping the marriage

[15] Although in this model the quality of the investment is exogenous it could be interesting to endogenise the decision.

[16] See Appendix E for a detailed description of the beliefs supporting the PBE.

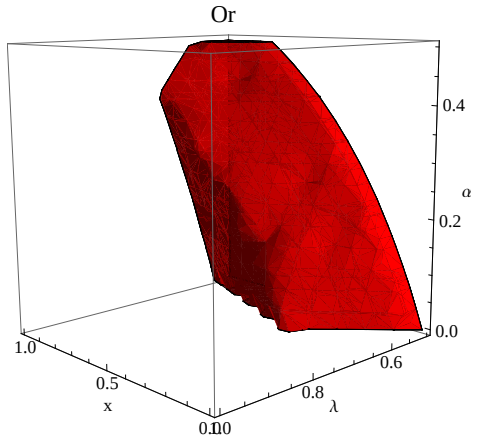
[17] In couples where the wife is careless and $\frac{1-\alpha}{\alpha} t_w < \frac{3}{4}$, divorce does not arise either and the wife does not invest in the public good in the second period.

with an increase of the relative time and preferences for the public good ($\frac{\partial({U_l}^d - {U_l}^m)}{\partial t_w} > 0$ and $\frac{\partial({U_l}^d - {U_l}^m)}{\partial \alpha} < 0$). Consequently, couples in transition from Beckerian to gender-equality families face divorce.

In an *unstable family* where the relative time of the wife and her inclination towards the public good are higher than a a certain threshold ($\frac{1-\alpha}{\alpha} t_w > 1$), the husband does not contribute to the creation of the public good in the second period. Divorce decreases with the preference of the wife towards the public good and only arises with relatively careless wives ($\alpha > 2/5$). Caring wives with high enough relative time available that are self-sufficient in the public good provision in the second period do not get divorced if the husband spends high enough time with their children in the first period. Caring women decide to continue with the marriage and be the sole investor in the second period to presumably avoid any harm that divorce could cause to their children.

Figure 4 represents all combinations of relative time, preferences of the wife and quality of the investment that lead to divorce.

Figure 4: Divorce



Note 1: x represents time of the wife (t_w).

Note 2: Values for λ lower than $\frac{1}{2}$ are not shown given that the marriage is always ended and it can be observed that there exists a λ^a above which divorce does never arise.

5 Empirical Implications

There are two main empirical implications of the model that arise from Proposition 5 and Proposition 6.

Proposition 5 offers an explanation of divorce based on low public good creation. It is therefore consistent with the existence of a hold up problem within the family driven by the possibility of divorce in the future. The inability to commit to a future continuity of the marriage might provoke lower investments in household public goods, leading to actually divorcing. The empirical

implication of this finding is a negative relationship between time that fathers spend with their children and the likelihood of divorce.

Implication 1. *Paternal time decreases the likelihood of divorce.*

Implication 1 is of crucial importance to understand human capital formation. Investments in human capital during the first years of life are essentially composed by parental time. Hence, children whose parents divorce are exposed to having received lower human capital investment. A description of the expected effects of parental time on future outcomes was presented in the literature review so I will not address it here again.

Proposition 6 states that the quality of the investment is an essential determinant of the divorce decision and that divorce is more likely to arise when the time invested in the first period is of a low quality.

Implication 2. *The higher the quality of the time spent with children, the lower the likelihood of divorce.*

In the PSID-CDS sample, parents spend two types of time with their children: participation time (high quality time) and presence time (low quality time). Participation time refers to the time that parents and children are jointly involved in an activity. Presence time is time that parents are present but not taking part in the activity their children is involved in. According to the above implication, fathers' participation in children activities has a higher effect on preventing divorce than just passively taking care of them but without taking part in their activities.

6 Data and Methods

6.1 Sample Selection and Descriptive Statistics

To conduct the study, I extract the data from the Panel Study of Income Dynamics (PSID), a longitudinal study of a representative sample of US individuals and their households. The study began in 1968 with 5000 households and 18.000 individuals reaching 65.000 individuals in 2003. The Survey Research Center, Institute for Social Research, University of Michigan is in charge of the PSID data collection and cleaning.

The core PSID, Marriage History Supplement (MHS) and Child Development Supplement (CDS) are the main sources of my research. In 1997, the PSID supplemented its core data collection with additional information on PSID parents and their 0-12 year-old children. The CDS started in 1997 with 2394 families and 3563 children. These families are re-contacted in 2002-2003 and 2007. We find two sorts of data in the CDS; first, questionnaires on family environment and developmental outcomes of children, obtained from the answers of Primary and Secondary Care Givers of the children, (mother and father, respectively); second, a time diary on children's activities. The diary is a chronology of events starting at midnight with a number of entries per child that varies between

15 and 40. The time on the activities of each child in a certain day are recorded as well as whether anyone is present or participating with the child in the activity. Two time diaries are collected per child, one on a random school day (Monday through Friday) and other on a random weekend day (Saturday or Sunday).

I focus on a sample of CDS families that are "intact" in 1997 i.e. married couples and their biological children. After keeping just those families with information on the time spent with their children, the final sample has 1645 children and 1102 families. For 10 year, 1997 to 2007, I study the relationship between the decision of divorce and family characteristics with special focus on parental time. Disparities between "intact" and "divorced" families are visible, although stronger differences arise between families that divorce during the first 5 years of the study (1997-2002) and "intact" families.

First three columns of Table 1 present variables' means in 1997 and columns 4 to 7 in 2002. The first column reports means for children whose parents were married in 1997 and remained married by the end of 2002 and the second for children whose parents divorced between 1997 and 2002. The third reports difference in means and significance levels. The fourth column of Table 1 presents variable means for children whose parents were married in 2002 and remained married by the end of 2007 and the fifth children for children whose parents divorced between 2002 and 2007 with their differences in means and significance levels reported in the last column. Out of an initial sample of 1484 children, the parents of 176 divorce between 1997 and 2002. There is information on parental time and marital status for 1071 at the end of 2002 out of which 97 get divorced between 2002 and 2007. [18]

Children of families that eventually divorce are likely to be younger with younger parents which, on average, are likely to have been married for fewer months than parents of intact families. The proportion of mothers experiencing their first marriage is higher for intact couples. The labour and economic status of divorced and intact families is likely to be diverse. The average income of a family that does not divorce in the subsequent five years is likely to be much higher than of a family whose parents divorce. Spouses that eventually divorce are likely to earn a considerably lower wage and are more likely to be unemployed or inactive. Not surprisingly and in line with previous findings, the educational level of parents in intact families is likely to be higher than of parents in divorced families. On average, parents in intact families are more likely to hold university degrees or postgraduates studies and less likely to have left education after finishing primary or secondary school. Racial and religious differences are also likely to arise between intact and divorce families. On the one hand, among the divorcees there is a considerable lower proportion of catholics than among the intact families. On the other hand, the proportion of black families among divorcees is considerably higher.

[18] Note that 61 children have information on parental time in 2002 and not in 1997.

Table 1: Summary Statistics

	Year 1997			Year 2002		
	Intact	Divorce	Dif.	Intact	Divorce	Dif.
Age Children	5.998	5.261	0.737**	11.013	10.237	0.776*
Age Father	37.537	34.733	2.805***	42.493	41.216	1.277*
Age Mother	35.492	32.500	2.992***	40.523	38.711	1.812***
Sex of Children*	0.501	0.540	-0.039	0.500	0.392	0.109**
Children in Family Unit	2.283	2.170	0.112	2.248	2.237	0.011
Duration of Marriage	140.000	112.784	27.216***	200.810	174.608	26.202***
Father First Marriage	0.866	0.795	0.071**	0.875	0.876	-0.001
Mother First Mariage	0.898	0.852	0.046*	0.905	0.845	0.059*
Employment and Income						
Mother in Employemnt	0.644	0.540	0.105***	0.698	0.670	0.028
Father in Employemnt	0.943	0.909	0.034*	0.945	0.907	0.038
Labour Income Mother	18.526	12.668	5.858***	22.111	23.215	-1.103
Labour Income Father	48.558	35.468	13.090***	62.805	63.295	-0.490
Family Income	76.130	54.158	21.971***	99.069	118.446	-19.377
Education Father						
No Primary Education	0.048	0.028	0.020	0.035	0.052	-0.017
Primary Education	0.101	0.165	-0.064**	0.092	0.082	0.010
Secondary Education	0.512	0.670	-0.158***	0.514	0.639	-0.125**
University Degree	0.205	0.068	0.137***	0.214	0.155	0.059
Postgraduate Studies	0.105	0.062	0.042*	0.114	0.041	0.073**
Education Mother						
No Primary Education	0.037	0.023	0.015	0.026	0.072	-0.046**
Primary Education	0.097	0.170	-0.073***	0.091	0.113	-0.023
Secondary Education	0.561	0.676	-0.115***	0.556	0.588	-0.032
University Degree	0.196	0.045	0.150***	0.211	0.113	0.098**
Postgraduate Studies	0.076	0.057	0.019	0.082	0.052	0.031
Race						
Both Black	0.180	0.301	-0.121***	0.166	0.381	-0.215***
Both Same Race–Other	0.119	0.051	0.067***	0.104	0.062	0.042
Different Race	0.046	0.034	0.012	0.049	0.072	-0.024
Religion						
Both Catholics	0.229	0.119	0.109***	0.225	0.144	0.081*
Both Protestants	0.458	0.500	-0.042	0.459	0.495	-0.035
Both Same Religion–Other	0.050	0.057	-0.006	0.045	0.082	-0.038*
Non-Religious	0.026	0.062	-0.037***	0.024	0.031	-0.007
Different Religion	0.237	0.261	-0.024	0.246	0.247	-0.001
Time with Children						
Father						
Participates Weekend	4.024	3.319	0.705***	3.238	2.455	0.782**
Participates Weekday	1.540	1.694	-0.154	1.303	0.848	0.455**
Present Weekend	3.043	2.899	0.144	2.765	2.604	0.161
Present Weekday	1.364	1.223	0.141	1.510	1.707	-0.197
Mother						
Participates Weekend	5.085	4.894	0.191	3.795	3.649	0.146
Participates Weekday	3.098	3.270	-0.172	1.984	1.668	0.317
Present Weekend	3.826	3.845	-0.018	3.147	3.436	-0.289
Present Weekday	2.623	2.706	-0.083	2.175	2.307	-0.132
Observations	1308	176		1071	97	

*p<0.1, **p<0.05, *** p<0.01

As pointed out in Section 3.1, labour decisions determine parental time during weekdays. Given that I do not intend to deal with the labour supply decision, I conduct separate analysis according to the day of the time diary. Following Yeung et al. (2001) and Rasmussen (2009), I distinguish between *weekend time* and *weekday* time. Furthermore, time diaries report information on who is present or participating during children's activity. Therefore, I further classify parental time in *participation time* which refers to time that parents take part in children's activity, and *presence time* which corresponds to time that parents take care of their children but are not involved in their activity. [19]

Table 1 shows that fathers of intact families are likely to spend an average of 40 minutes more in the weekend day participating with children than fathers of divorced families, both in 1997 and 2002. In 2002, fathers that divorce are likely to participate on children activities on average significantly less time than fathers that do not divorce. Fathers of intact families spend an average of 7 hours with their children in 1997 and 6 hours in 2002 in the weekend day while fathers of divorced families 6 hours in 1997 and 5 hours in 2002. There is almost no difference in the average time that fathers spend with their children on weekdays: both intact and divorce fathers spend on average 2.9 hours in 1997 while in 2002 fathers of intact families spend 2.8 hours and fathers of divorced 2.6. Mothers devote considerably more time to their children than fathers and the time does not vary with the prospective marital status. While in 1997 mothers spend and average of almost 9 hours during the weekend day (8.9 for intact and 8.7 divorce families), they spend an average of 7 hours in 2002 (6.9, intact and 7.1, divorced). Finally, on a random weekday, mothers spend on average considerably less time with their children: an average of 6 hours in 1997 and 4 in 2002.

6.2 Pooled Pobit

Table 5 presents further evidence on the relationship between parental time and divorce. I estimate a binary model for the probability of getting divorced between 1997 and 2010, $P(y = 1|x) = G(X'\beta)$, where G is a function that takes values between 0 and 1. Given that I assume a probit specification, $G = \Phi(X'\beta)$.

Explanatory variables (X) are observed twice, in 1997 and 2002. Observables in 1997 affect the probability of divorce between 1997 and 2002 and those of 2002, the likelihood of divorce from 2002 to 2007. This study focuses on the relation between time invested on children (household public good) and divorce[20]Therefore, eight are the variables of interest: mother's and father's time in weekdays and weekend classified according to whether parents are participating or are just present during children's activities.

The rest of explanatory variables are the usual in the divorce literature: dummies for race, religion and education, cubic age of the father, difference of age of the parents, age and sex of children, number of children, employment status, duration of the marriage, number of marriages,

[19]Folbre et al. (2005) denotes participation time as direct childcare and presence time as indirect childcare.

[20]See Weiss and Willis (1997) for a complete analysis of family characteristics that determine the decision of divorce.

logarithm of family income and mother's labour income.

Results in first column of Table 5 show that father's time participating with children in weekends has a negative and significant effect on the probability of divorce. In fact, an extra hour spent during the reported day of the weekend lowers the probability of divorce by 0.5% points. A representative divorced family, family whose observable characteristics are at the median value of all divorced families, has a 9.9% probabilty of dissolving.[21] In contrast, their probability of dissolving would be 9.3% if the father spent an hour more participating with his children in the weekend (3.5 hours). Therefore, there is a 6% decrease in the probability of divorce if a father of a representative divorced family spends an hour more with his children during the weekend. Furthermore, a 16% increase in the probability of divorce is faced if the father does not participate at all with his children in the weekend. The probability of divorce would then be 11.5%.

Since hours at work during the week have a direct effect on parental time available while time available during the weekend is more likely to be the same across parents, the caring of the parents towards his children is better evaluated in the weekends. In fact, as pointed out in the theoretical section, parents that work more hours are likely to spend less time with their children while he proportion of available time could be higher. Furthermore, working hours and divorce could be decided jointly since couples that are about to divorce could spend more hours at work and as a consequence spend less time with their children.

6.3 Econometric Method

I estimate the following hazard function to analyse the transition from marriage to divorce,

$$h(t_i) = h_0(t_i)e^{{x_i}^t\beta} \tag{5}$$

where $h_0(t)$ is the baseline hazard function i.e. hazard function at values of time and covariates equal to 0. The hazard of divorce of parents of child i is a function of the length of their marriage, t, and family and children characteristics, x_i, which are those of the probit estimation. The sample of married couples with children used for the analysis is left truncated so that just marriages that survived until 1997 are considered and right censored, meaning that the behaviour of families is not observed after 2007.

I present the estimates of the above hazard function using both a Cox proportional hazard model and a Weibull model. A Cox model is a semi-parametric model for continuous survival time, first proposed by Cox (1972). The β coefficients are retrieved using the method of partial likelihood that does not require the assumption of a functional form for the baseline hazard function in Equation

[21] The representative children is choosen to be a 7 years old girl with employed, white and Protestant parents that have been married for 11 years and have another children. Their highest education attained is secondary school. The dad is 37 years old and the mum two years younger. Their annual family income is 55.000 $ and annual labour income of the mother, 10.700 $. The mum participates in children activities during the surveyed weekend day during 4.3 hours and the dad during 2.5 and she is present during 3.25 hours and the dad for 2. On the weekday she is both present and participating for 2 hours and the dad for less than an hour.

5. [22] In contrast, a Weibull model assumes a parametric specification for the baseline hazard (the hazard function is $h_{it} = \alpha t^{1-\alpha} e^{\beta' X}$) and is estimated by maximum likelihood.[23]

Observed covariates, however, might not account for all the variability in time to divorce. In the presence of omitted variables or misspecification of the model proposed, the previous analysis cannot account for individual's unobserved heterogeneity (or frailty) towards divorce. The lasting of the marriage might be correlated within the same individual over time or within children in the same family. I account for shared frailty which is a latent common group effect or unobserved characteristics shared among individuals of a certain group, in this case families. I re-estimate Equation 5 scaled by an unobserved frailty effect, $\alpha : h(t_{ij}|\alpha_i) = \alpha_i h(t_{ij})$ where i represents family and j children. [24]

Previous to the estimation results, Figure 1 depicts smoothed hazard of divorce. The hazard of divorce rises during the first years of marriages until it reaches a maximum at 7 years and it then starts decreasing. The interpretation of the existence of imperfect information at the time of marriage is therefore plausible: couples get married without having perfect knowledge about the characteristics of the spouse (type of spouse). As time passes and after having observed the investments on household public goods, individuals have a better picture of their partner and those that are not satisfied with marriage get divorced.

7 Results

7.1 Basic Results

Results highlight paternal participation time during the weekend lowers the hazard of divorce. Implication 1 and Implication 2 of my model are hence satisfied. On the one hand, the more time the father spends with his children during the weekend the lower the hazard of divorce. On the other hand, just participation time and not presence time affects the hazard of divorce so that the higher the quality of time the lower the hazard of divorce.

Second and third columns of Table 5 report the estimated exponentiated coefficients (e^{β}) of Cox and Weibull Models. The hazard of divorce lowers between 5 and 6% points if fathers spend an hour more with their children. Furthermore, neither weekeday nor presence time have a significant

[22] See Klein and Moeschberger (2003) for a complete description of the methodology, how to account for left truncation, right censoring and time varying covariates

[23] In order to choose the correct parametric specification a first graphical test is conducted. The graph (Graph 1) together with the results of the Log-Likelihood and Akaike Informative Criterion values determine that it is the Weibull model the bestly fitted parametric specification. See Jenkins (2005) for a thorough explanation of the graphical test and for a for a description of the parametric functions. The log-likelihood function to be maximised is $Log\mathcal{L} = \sum_{i=1}^{n} c_i log\theta(T_i) + log[w_i S(T_i)]$ where c_i takes the value of 1 if the observation is right censored and 0 otherwise and $w_i = \frac{1}{S(\tau_i)}$ is a weighting variable that uses an inverse probability of inverse entry to control for left truncation.

[24] Frailties, α_i, are unobserved positive numbers of mean 1 and finite variance distributed independently of t and x and to be estimated from the data. The estimate of the variance of α_i is used to measure the degree of within-group correlation and is assumed to have a gamma distribution for the sake of the estimation.

effect on the hazard of divorce. Accounting for unobserved heterogeneity, column 4, an extra hour of paternal participation during the weekend decreases parental hazard of divorce by 8% points among children with equal frailty. Besides, the frailty term(θ) is highly significant.

Table 2: Basic Results

	Probit ($\Phi(X'\beta)$)	**Cox**	**Weibull** ($\alpha t^{1-\alpha} e^{\beta' X}$)	
				Unob. Heterog.
	ME	e^{β}	e^{β}	e^{β}
Father				
Participates Weekend	-0.005** (0.002)	0.941** (0.027)	0.945** (0.027)	0.915* (0.043)
Participates Weekday	-0.001 (0.004)	0.987 (0.047)	0.989 (0.048)	1.054 (0.078)
Present Weekend	-0.003 (0.003)	0.964 (0.034)	0.962 (0.034)	0.935 (0.046)
Present Weekday	-0.002 (0.004)	0.972 (0.050)	0.975 (0.050)	1.050 (0.078)
Mother				
Participates Weekend	-0.001 (0.002)	0.983 (0.029)	0.982 (0.029)	0.947 (0.042)
Participates Weekday	-0.004 (0.003)	0.966 (0.039)	0.964 (0.039)	0.877** (0.057)
Participates Weekday	0.002 (0.003)	1.027 (0.039)	1.029 (0.038)	1.001 (0.051)
Present Weekday	0.001 (0.003)	1.023 (0.037)	1.023 (0.038)	0.966 (0.059)
p			0.791	6.202
Theta				25.645***
Chi-2	125.9288	99.92731	102.19	140.2629
Log-Likelihood	-785.752	-1597.828	-555.0508	-396.0683
Akaike's Info. Crit.		3269.655	1188.102	872.1367
N^o Children	2651	1645	1645	1645
N^o Families	1072	1102	1102	
N^o Failures		273	273	273

*p<0.1, **p<0.05, *** p<0.01. Standard errors are clustered at the family level.

In addition, a new result arises from the Weibull model with shared frailty: an extra hour of maternal participation time in the reported week day decreases parental hazard of divorce among children with the same frailty by 12%. points. Finally, the effect of the regressors on the hazard of divorce are considerably stronger in the share frailty model than in the model without accounting for unobserved heterogeneity. Graph 3 illustrates the estimated population hazards of the Weibull model with and without frailty.

Finally, I would like to highlight that my first and most important goal in this paper is to show the existence of a relationship between parental investments and divorce. I acknowledge that there might be an endogeneity problem arising from unobserved variables being correlated with both the time spent with children and the decision of divorce that could bias my estimates. Therefore, I am not intending to claim the existence of a causal relationship between paternal time and divorce.

7.2 Categories of Time and Togetherness

7.2.1 Descriptive Statistics

Each "type of time" affects differently the utility of marriage and, as a consequence, the divorce decision. In this section, I classify parental time according to children's activities and investigate their different effects on the probability of divorce. I consider four categories of children activities: child care, leisure, household tasks and social activities.[25] Child care not only relates to time when children receive care but also to time spent at meals or "educational" activities such as doing the homework or reading a book. Leisure embraces both passive and active leisure activities whereas I classify shopping of goods or services and adult care' as household tasks. Religious, volunteering or political activities are, for instance, classified as social activities. These categories follow from the time diary groups and the restriction in the number of activities is due to the limited number of observations.

Time of one parent with his or her children has a different effect in the hazard of divorce than time of both parents with their children i.e. family time. Therefore, in addition to the type of activity, I evaluate the importance of parental "togetherness".[26] The analysis focuses on activities conducted during the weekend given that the decision between working and spending time at home might bias the results during weekdays. Having observed that presence time does not have a significant effect on the probability of divorce, I restrict the analysis to participation time.

Table 3 summarises the differences of parental time according to children's activity and togetherness. Mothers are likely to spend on average more time than fathers in every children activity, independently of their future marital status. Besides, most of the time that fathers spend with children is observed to be conducted jointly. Excluding Social Activities, independent maternal time is on average lower for intact couples than for divorced. On the contrary, average joint parental time is higher. Finally, except for household tasks, not significant differences in average independent paternal time are observed.

In line with previous considerations, not significant average differences in total (independent and joint) parental time are observed between intact families and families that dissolve between 2002 and 2007. On the contrary, a few differences worth mentioning are observed between intact families and families that divorce between 1997 and 2002. On the one hand, total paternal time devoted to household tasks is likely to be lower in divorce than in intact couples. This difference in time spent in household tasks holds whether the time is spent with or without the mother participating. On the other, total maternal time spent in social activities with or without the participation of the father is likely to be higher on average for intact than for divorced families. Similarly, average total time that fathers spend on social activities is likely to be higher for intact couples although such a difference is observed to be captured by joint time on social activities.

[25] Seen Yeung et al. (2001) for a further decomposition of parental time.

[26] Terminology extracted from Hamermesch 2002.

Leisure is documented to be the activity occupying the largest fraction of parental time as well as having the lowest average time differences among parents. In addition, children are likely to spend their leisure time with both parents while those parents that divorce in the second period are likely to spend less average time together and with their children on leisure. In the first period when children are younger, Child Care is the second activity in terms of average parental time devoted to it while in the second, average paternal time devoted to Child Care is lower for divorced than intact families.

Table 3: Categories of Time and Togetherness

	Year 1997			*Year 2002*		
	Intact	*Divorce*	*Difference*	*Intact*	*Divorce*	*Difference*
Total Parental Time						
Total Father						
Chid Care	1.001	0.856	0.145	0.810	0.612	0.198*
Household Tasks	0.570	0.309	0.262***	0.423	0.308	0.116
Leisure Activities	1.623	1.628	-0.006	1.276	0.987	0.289
Social Activities	0.830	0.527	0.304**	0.700	0.549	0.151
Total Mother						
Chid Care	1.509	1.636	-0.127	0.951	0.893	0.058
Household Tasks	0.867	0.732	0.135	0.734	0.876	-0.143
Leisure Activities	1.685	1.944	-0.259*	1.235	1.179	0.057
Social Activities	1.023	0.582	0.441***	0.873	0.701	0.173
Independent and Joint Parental Time						
Independent Father						
Chid Care	0.205	0.195	0.010	0.132	0.081	0.051
Household Tasks	0.182	0.100	0.082*	0.127	0.116	0.011
Leisure Activities	0.669	0.695	-0.026	0.518	0.501	0.017
Social Activities	0.115	0.063	0.051	0.100	0.138	-0.038
Joint						
Chid Care	0.796	0.660	0.135	0.678	0.531	0.147
Household Tasks	0.388	0.209	0.180**	0.297	0.191	0.105
Leisure Activities	0.953	0.933	0.020	0.758	0.486	0.272*
Social Activities	0.716	0.464	0.252**	0.599	0.411	0.189
Independent Mother						
Chid Care	0.714	0.975	-0.262***	0.273	0.363	-0.089
Household Tasks	0.479	0.524	-0.045	0.437	0.685	-0.248**
Leisure Activities	0.732	1.011	-0.279***	0.478	0.692	-0.215*
Social Activities	0.308	0.118	0.189**	0.274	0.290	-0.016
Observations	1308	176		1071	97	

*p<0.1, **p<0.05, *** p<0.01

7.2.2 Results

Results lead to three main conclusions. First, the dissipation of gender roles within the household contribute towards the stability of the family.[27] Whenever the entire family participates in duties traditionally assigned to women the hazard of separation decreases. Second, families that spend more leisure and social time together have a lower hazard of divorce. Finally, the degree of settlement of the mother in the society and in her children social environment increases her well-being and her costs of getting divorced. Social activities of the mother with her children positively influences the well-being of the mother as well as increases the social cost of the separation.

Table 4 presents the effects of the four types of parental time on the hazard of divorce. First column of Table 4 presents the estimates of Equation 5 using a Cox model, second column using a Weibull model and third column using a Weibull model but accounting for unobserved heterogeneity. Results highlight maternal time participating in social activities and paternal time participating in household tasks significantly decrease the hazard of divorce.

On the one hand, an increase of an hour in total paternal time spent on household tasks decreases the hazard of divorce by 17% points according to both Cox and non-frailty Weibull models. If unobserved heterogeneity is not accounted for, fathers' time with children in household tasks seems to be captured by total family time spent in household activities. However, accounting for unobserved heterogeneity, results show that just father and children's time, without the involvement of the mother, affects the likelihood of divorce. In fact, the hazard of parental divorce decreases by 40% points in children with the same level of frailty if just fathers and children spend an extra hour together in household tasks.

On the other hand, time that mothers spend in social activities have a strong effect on the hazard of divorce. Divorce decreases by 20% points with an extra maternal hour on social activities according to the non-frailty models estimates and decreases by 28% points among children with the same frailty. Consistently, the hazard of divorce decreases by 11% points with an extra hour of joint time in social activities and by 20% points with an hour of individual maternal time. The hazard of divorce in children with the same frailty decreases by 14% points with an extra hour of joint social time and by 35% points with an extra hour of individual maternal time in social activities. Finally, joint leisure time significantly decreases the hazard of divorce among children with equal frailty.

[27] This finding coincides with Tabasso (2010).

Table 4: Categories of Parental Time

	Cox	**Weibull** $(\alpha t^{1-\alpha} e^{\beta' X})$	
			Unob.Heter.
Controls for Total Parental Time	e^{β} (se)	e^{β} (se)	e^{β} (se)
Total Father			
Chid Care	0.919 (0.080)	0.930 (0.081)	0.850 (0.131)
Household Tasks	0.827** (0.078)	0.832* (0.078)	0.802 (0.117)
Leisure Activities	0.955 (0.046)	0.962 (0.048)	0.917 (0.071)
Social Activities	1.087 (0.091)	1.074 (0.089)	1.207 (0.145)
Total Mother			
Chid Care	1.043 (0.071)	1.037 (0.075)	1.001 (0.104)
Household Tasks	0.998 (0.061)	0.997 (0.060)	0.892 (0.079)
Leisure Activities	1.001 (0.047)	1.000 (0.049)	0.977 (0.075)
Social Activities	0.806***(0.066)	0.816** (0.066)	0.721***(0.090)
θ			24.275***(5.19)
p		0.923	5.929
Chi-2	113.558	112.996	142.071
Log-Likelihood	-1589.216	-548.578	-395.1642
Akaike's Info. Crit.	3254.433	1177.156	872.328
Controls for Independent and Joint Parental Time			
Independent Father			
Chid Care	0.903 (0.136)	0.934 (0.138)	0.736 (0.188)
Household Tasks	0.854 (0.128)	0.837 (0.127)	0.593** (0.153)
Leisure Activities	1.031 (0.062)	1.045 (0.062)	1.073 (0.105)
Social Activities	1.061 (0.144)	1.042 (0.144)	1.198 (0.226)
Joint			
Chid Care	0.964 (0.081)	0.967 (0.078)	0.879 (0.145)
Household Tasks	0.827* (0.084)	0.839* (0.085)	0.806 (0.141)
Leisure Activities	0.920 (0.047)	0.924 (0.047)	0.818*** (0.063)
Social Activities	0.891* (0.058)	0.893* (0.058)	0.862* (0.074)
Independent Mother			
Chid Care	1.036 (0.081)	1.034 (0.086)	0.954 (0.104)
Household Tasks	1.003 (0.064)	1.001 (0.063)	0.865 (0.081)
Leisure Activities	1.057 (0.052)	1.063 (0.054)	1.139 (0.113)
Social Activities	0.801** (0.081)	0.809** (0.080)	0.653*** (0.104)
θ			23.895*** (4.921)
p		0.932	5.930
Chi-2	121.5886	123.3512	151.7785
Log-Likelihood	-1587.116	-546.0772	-390.3105
Akaike's Info. Crit.	3258.231	1180.154	870.6211
N^o Children	1645	1645	1645
N^o Families	1102	1102	
N^oFailures	273	273	273

*p<0.1, **p<0.05, *** p<0.01. Exponentiated coefficients

8 Conclusion

This paper analyses the relationship between spouses' investments in household public goods and divorce. Making use of a simple signalling game, I find the existence of a negative relationship between investments and the decision of divorce. Specifically, the model proposed predicts divorce if one spouse does not devote enough time in the production of the household public good. The model also predicts that the quality of the investment is essential in taking the divorce decision: high quality time is related with lower likelihood of divorce.

In the empirical analysis, I use a sample of initially married couples with young children extracted from the Children Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID). Children and parental time represent household public good and investments, respectively. My empirical analysis supports the main prediction of the model finding a negative relation between the hazard of divorce and time that fathers spend with children. I also prove the importance of the quality of time showing that time that the father participates with his children increases survival time of the marriage whilst time that he is present but not participating in children activities does not have any significant effect.

Moreover, I find a lower hazard of divorce in families with weaker gender roles since the hazard of divorce decreases with father's and children's involvement in household tasks. Lastly, I show that the hazard of divorce decreases with family time in social and leisure activities as well as social time that the mother spends with her children, meaning that the degree of settlement of the family (and specially the mother) in the society and in their children social environment decreases the hazard of divorce.

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A Tables

The probability of divorce is significantly higher for young couples, it decreases as couples get older increasing slightly again probably when children are independent. Spouses with higher age differences are also more likely to get divorced. The labour status and economic independence of the mother show a significant effect on the probability of divorce. While mothers earning higher income have a slightly higher probability of divorce (1% points increase in income increases the probability of divorce by 0.0045% points) those that are in employment have a much lower probability of divorce (6.6% points).

Table 5: Basic Results

	Probit ($\Phi(X'\beta)$)	**Cox**	**Weibull** ($\alpha t^{1-\alpha} e^{\beta' X}$)	
				Unob. Heterog.
	ME (se)	e^{β} (se)	e^{β} (se)	e^{β} (se)
Age Children	-0.001(0.002)	1.003 (0.026)	0.986 (0.023)	1.103** (0.052)
Sex of Children* (d)	-0.011 (0.010)	0.889 (0.112)	0.884 (0.112)	1.041 (0.219)
Children in Family Unit	-0.008 (0.007)	0.927 (0.074)	0.920(0.074)	0.449*** (0.097)
Duration of Marriage	-0.000 (0.000)			
Age Father	-0.012** (0.006)	0.899* (0.054)	0.891* (0.057)	0.469*** (0.105)
$(AgeFather)^2$	0.000 (0.000)	1.001 (0.001)	1.001 (0.001)	1.006* (0.003)
Age Difference Parents	0.003 (0.002)	1.031 (0.027)	1.039 (0.027)	1.152** (0.081)
First Marriage Father (d)	-0.011 (0.025)	0.888 (0.243)	0.807 (0.219)	0.293 (0.220)
First Mariage Mother (d)	-0.048 (0.030)	0.665 (0.172)	0.631* (0.164)	0.035*** (0.030)
Log Labour Income Mother 97	0.005** (0.002)	1.049* (0.030)	1.049* (0.029)	1.120** (0.061)
l(Family Income)	-0.002 (0.011)	0.983 (0.132)	0.968 (0.127)	2.108** (0.695)
Father in Employemnt (d)	-0.027 (0.029)	0.714 (0.197)	0.717 (0.197)	0.305 (0.225)
Mother in Employemnt (d)	-0.067*** (0.025)	0.527*** (0.128)	0.528*** (0.128)	0.253*** (0.100)
Father No 1^{ary} Ed. (d)	-0.011 (0.047)	1.005 (0.643)	0.967 (0.575)	0.700 (1.042)
Father 1^{ary} Ed. (d)	0.001 (0.022)	1.019 (0.257)	1.030 (0.261)	0.665 (0.509)
Father Univ. Degree (d)	-0.028 (0.018)	0.697 (0.197)	0.694 (0.197)	0.438 (0.359)
Father Postgrad Studies (d)	-0.013 (0.026)	0.824 (0.321)	0.839 (0.328)	0.090** (0.101)
Missing Education Father (d)	-0.056** (0.022)	0.316* (0.213)	0.328 (0.223)	0.095 (0.157)
Mother No 1^{ary} Ed. (d)	0.120 (0.094)	3.203* (2.070)	3.233** (1.840)	4.984 (7.355)
Mother 1^{ary} Ed. (d)	0.029 (0.026)	1.387 (0.326)	1.351 (0.314)	3.497 (3.190)
Mother Univ. Degree (d)	-0.048*** (0.016)	0.488** (0.162)	0.494** (0.168)	0.066*** (0.053)
Mother Postgrad Studies (d)	0.002 (0.030)	0.928 (0.339)	0.972 (0.356)	2.481 (2.672)
Missing Education Mother (d)	-0.009 (0.030)	0.801 (0.314)	0.892 (0.342)	1.103 (1.266)
Both Black (d)	0.055** (0.022)	1.670** (0.343)	1.756*** (0.358)	4.598** (2.918)
Both Same Race–Other (d)	-0.061*** (0.018)	0.299** (0.161)	0.301** (0.164)	0.066*** (0.065)
Different Race (d)	0.006 (0.026)	1.197 (0.354)	1.207 (0.361)	4.410 (5.003)
Both Catholics (d)	-0.006 (0.022)	0.887 (0.281)	0.912 (0.290)	1.794 (1.133)
Both Same Religion–Other (d)	0.037 (0.039)	1.292 (0.443)	1.331 (0.455)	12.171** (13.534)
Non-Religious (d)	0.073 (0.055)	1.880* (0.690)	1.947* (0.702)	2.599 (4.064)
Different Religion (d)	0.004 (0.017)	1.067 (0.209)	1.093 (0.217)	5.367* (4.975)
Constant			0.892 (1.580)	0.000** (0.000)

*p<0.1, **p<0.05, *** p<0.01. Standard errors are clustered at the family level.

Moreover, the effect of the educational level is significant for both fathers and mothers. Fathers holding an university degree have a 3% points lower probability of divorce than those that left education after finishing secondary school while mothers a 4.8% points. Race of the spouse are also signinficant in determining the probability of getting divorced. Black parents have a 5% points higher probability of divorce than whites and those that are from the same race neither Black nor White a 5.8% points lower than whites.

Table 6: Parametric Duration Models

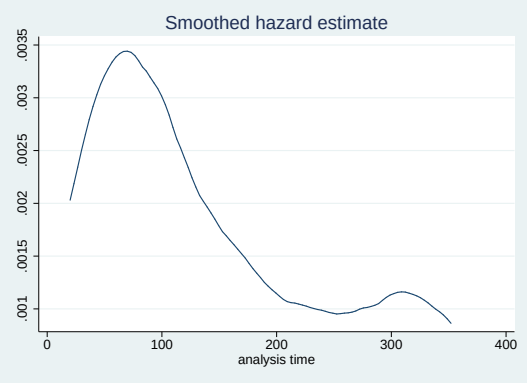
	Exponential		**Log-Logistic**		**Log-normal**	
		Unob. Heterog.		Unobs. Heterog.		Unobs. Heterog.
Father						
Participates Weekend	0.945**	0.920**	1.074*	1.015	1.074**	1.028**
	(0.027)	(0.034)	(0.043)	(0.013)	(0.038)	(0.015)
Participates Weekday	0.989	1.014	1.013	0.982	1.020	0.982
	(0.048)	(0.062)	(0.055)	(0.017)	(0.052)	(0.019)
Participates Weekday	0.963	0.942	1.048	1.018	1.043	1.023
	(0.034)	(0.039)	(0.049)	(0.013)	(0.044)	(0.014)
Present Weekday	0.976	1.034	1.035	0.997	1.038	0.991
	(0.050)	(0.065)	(0.065)	(0.019)	(0.059)	(0.022)
Mother						
Participates Weekend	0.983	0.968	1.027	1.022*	1.027	1.020
	(0.029)	(0.035)	(0.041)	(0.011)	(0.035)	(0.013)
Participates Weekday	0.967	0.896**	1.085	1.028*	1.073	1.034**
	(0.039)	(0.046)	(0.068)	(0.016)	(0.055)	(0.017)
Participates Weekday	1.027	1.032	0.972	1.007	0.975	1.012
	(0.038)	(0.042)	(0.041)	(0.013)	(0.039)	(0.015)
Present Weekday	1.022	0.993	1.000	1.006	0.997	1.024
	(0.038)	(0.049)	(0.047)	(0.013)	(0.042)	(0.016)
γ			0.861	0.183		
σ					1.33952	.3693428
θ		10.40182		14.36126		13.88879
Log-Likelihood	-555.6151	-426.0464	-554.4975	-404.8238	-554.2664	-409.8103
Chi-2	145.1634	100.7085	58.96728	127.313	54.84904	118.1382
Akaike's Info. Crit.	1187.23	930.0928	1186.995	889.6475	1186.533	899.6206
N Children	1645	1645	1645	1645	1645	1645

Exponentiated coefficients

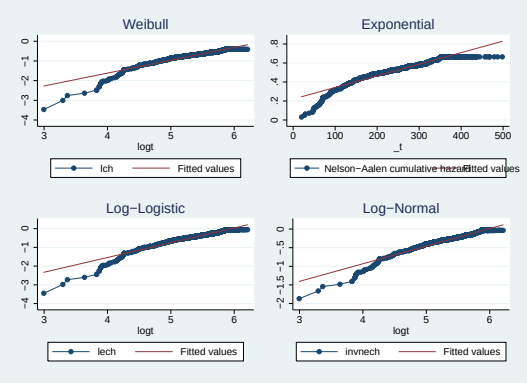
*p<0.1, **p<0.05, *** p<0.01

B Graphs

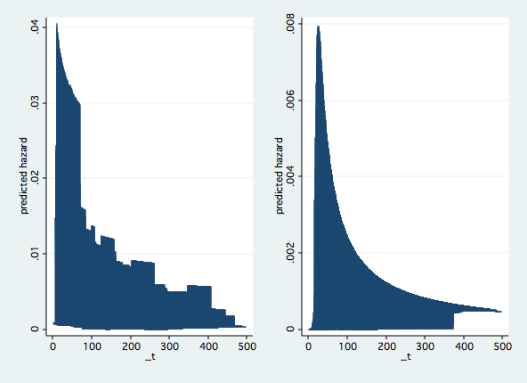
Graph1:



Graph 2:



Graph 3:



C Model

C.1 Simulation of Careless type

The following table illustrates the PBE of the model according to the type of wife, housework distribution within the family and quality of first period investments.

Table 7: Careless Husband

	MARRIAGE		**DIVORCE**
	Divorce constraint	Unconstrained choice	$g_d^1 = \frac{1}{2}$
Quality: $\lambda = \frac{2}{3}$			
Carless Wife ($\alpha = \frac{1}{2}$)	$0 < t_w < 1$	——	——
Average Wife ($\alpha = \frac{1}{4}$)	$0 < t_w < 0.61$ $0.78 < t_w < 1$	——	$0.61 < t_w < 0.78$
Caring Wife ($\alpha = \frac{1}{10}$)	$0 < t_w < 0.4$ $0.54 < t_w < 1$	——	$0.4 < t_w < 0.54$
Quality: $\lambda = \frac{3}{4}$			
Average Wife	——	$0 < t_w < 1$	——
Quality: $\lambda = 1$			
Average Wife	——	$0 < t_w < 1$	—— ——

The equilibrium choices are denoted as g_i^{tj} and the utilities as U_i^{tj} where $i = l, h, w$ referst to either the low type husband, l, the high type husband, h, or the wife, w. Periods are $t = 1, 2$ and $j = d, m$ denotes marriage or divorce path.

C.2 Second Period

Proof of Proposition 1
The second period expected utilitites of divorce and pooling equilibria are compared in Section C.2.4 and the utility of keeping the marriage is always higher.

Proof of Proposition 2
Comparative statics on the below obtained equilibrium choices in the remarriage equilibrium, low type separating equilibrium and high type separating equilibrium.

Proof of Proposition 3 and Proof of Proposition 5
Proved in Section 6 by comparing the utilities in the second period in divorce, in a high type sepa-

rating equilibrium and in a low type separating equilibrium.

C.2.1 Remarriage Solution

Low Type Husband.

$$
\begin{aligned}
Kuhn-TuckerConditions: \quad & \frac{1}{2}\Big(\frac{1-g_l^{2d}}{g_l^{2d}+g_w^{2d}}\Big)^{\frac{1}{2}} - \frac{1}{2}\Big(\frac{g_l^{2d}+g_w^{2d}}{1-g_l^{2d}}\Big)^{\frac{1}{2}} \leq 0 \\
& g_l^{2d} \geq 0 \\
& 1 - g_l^{2d} \geq 0 \\
& g_l^{2d}\big(\frac{\partial U_l^{2d}}{\partial g_l^{2d}}\big) = 0 \\
& (1-g_l^{2d})\big(\frac{\partial U_l^{2d}}{\partial g_l^{2d}}\big) = 0 \\
Best\ Response\ Function: \quad & g_l^{2d} = \frac{1}{2}(1-g_w^{2d}) \ and \ 1 > g_w^{2d} > 0
\end{aligned}
$$

High Type Husband *Best Response Function:* $g_h^{2d} = 1$

Wife *Best Response Function:*

$$
g_w^{2d} = \begin{cases} 0 & if \quad t_w < \frac{\alpha}{2(1-\alpha)}(g_l^{2d}+g_h^{2d}) \\ (1-\alpha)t_w - \frac{\alpha}{2}(g_l^2+g_h^2) & otherwise \end{cases}
$$

Equilibrium

$$
(g_h^{2d*}, g_l^{2d*}, g_w^{2d*}) = \begin{cases} (1, \frac{1}{2}, 0) & \text{if } t_w < \frac{3\alpha}{4(1-\alpha)} \\ (1, \frac{2+\alpha-2(1-\alpha)t_w}{4-\alpha}, \frac{4(1-\alpha)t_w-3\alpha}{4-\alpha}) & \text{otherwise} \end{cases}
$$

C.2.2 Separating Equilibrium: High Type

Best Response Functions:[28] $g_h^{2m} = 1$

$$
g_w^{2m} = \begin{cases} 0 & \text{if} \quad \lambda g_h^1 > \frac{1-\alpha}{\alpha}t_w - 1 \\ (1-\alpha)t_w - \alpha(1+\lambda g_h^1) & \text{otherwise} \end{cases}
$$

Equilibrium

$$
(g_h^{2m*}, g_w^{2m*}) = \begin{cases} \Big(1\ ,\ 0\Big) & \text{if} \quad \lambda g_h^1 > \frac{1-\alpha}{\alpha}t_w - 1 \\ \Big(1\ ,\ (1-\alpha)t_w - \alpha(1+\lambda g_h^1)\Big) & \text{otherwise} \end{cases}
$$

[28] According to the definition of sequential equilibrium, condition 2.b requires $p_{g_l^1} = 0$ and $pg_h^1 = 1$ if $g_l^1 \neq g_h^1$.

C.2.3 Separating Equilibrium: Low Type

Best Response Functions:

$$g_l^{2m} = \begin{cases} 0 & \text{if} \quad 1 < g_w^m + \lambda g_l^1 \\ \frac{1}{2}(1 - g_w^m - \lambda g_l^1) & \text{otherwise} \end{cases}$$

$$g_w^{2m} = \begin{cases} 0 & \text{if} \quad \lambda g_l^1 > \frac{1-\alpha}{\alpha} t_w - g_l^m \\ (1-\alpha)t_w - \alpha(g_l^2 + \lambda g_l^1) & \text{otherwise} \end{cases}$$

Equilibrium

$$(g_l^{2m*}, g_w^{2m*}) = \begin{cases} \left(\frac{1-(1-\alpha)(t_w+\lambda g_l^1)}{2-\alpha} \ , \ \frac{2(1-\alpha)t_w - \alpha(1+\lambda)g_l^1}{2-\alpha} \right) & \text{if} \quad \lambda g_l^1 < \frac{1}{1-\alpha} - t_w \ and \ \lambda g_l^1 < \frac{2(1-\alpha)}{\alpha} t_w - 1 \\ \left(\frac{1}{2}(1 - \lambda g_l^1) \ , \ 0 \right) & \text{if} \quad \lambda g_l^1 > \frac{2(1-\alpha)}{\alpha} t_w - 1 \\ \left(0 \ , \ (1-\alpha)t_w - \alpha \lambda g_l^1 \right) & \text{if} \quad \frac{1}{1-\alpha} - t_w < \lambda g_l^1 < \frac{1-\alpha}{\alpha} t_w \end{cases}$$

C.2.4 Pooling Equilibrium

Remember that wife's prior beliefs about the types are assumed to be the same as the beliefs in the remarriage game, $p = \frac{1}{2}$.

(i) If both the wife does not invest in the public good in divorce and expects the husband to invest $\frac{1-\alpha}{\alpha} t_w > \frac{3}{4}$, the expected utility of the wife in divorce is $U_{w_{(wc)}}^{2d} = \frac{3\alpha^\alpha (1-\alpha)^{1-\alpha}(t_w+1)}{4-\alpha}$

(a) Both spouses invest in the public good in the second period if in a pooling equilibrium if the choice in the first period, g^1, satisfies the following conditions $\lambda g^1 \leq \frac{4t_w(1-\alpha)-3\alpha}{3\alpha}$ and $\lambda g^1 \leq \frac{2+\alpha-2(1-\alpha)t_w}{2(1-\alpha)}$. If this is the case, the utility obtained by the wife is $U_w^{2m} = \frac{3\alpha^\alpha (1-\alpha)^{1-\alpha}(t_w+1+\lambda g^1)}{4-\alpha}$. As long as $\lambda g^1 > 0$ the utility of marriage is always higher than the utility of divorce

(b) The wife does not invest in the public good in the second period while the husband does if $1 \geq \lambda g^1 > \frac{4t_w(1-\alpha)-3\alpha}{3\alpha} t_w$ and she obtains an utility of $U_{w_{(wc)}}^{2m} = \frac{3}{4}^{1-\alpha} t_w^\alpha (1 + \lambda g^1)^{1-\alpha}$. Substituting $\lambda g^1 \leq \frac{4t_w(1-\alpha)-3\alpha}{3\alpha}$ in U_w^{2m} leads to the contradiction $\frac{1-\alpha}{\alpha} t_w < \frac{3}{4}$

(c) The husband does not invest in the second period while the wife does if $\frac{2+\alpha-2(1-\alpha)t_w}{2(1-\alpha)} < \lambda g^1$ and $\lambda g^1 < \frac{2t_w(1-\alpha)-\alpha}{2\alpha}$. The utility of the wife is $U_{w_{(hc)}}^{2m} = \alpha^\alpha (1-\alpha)^{1-\alpha}(t_w + \frac{1}{2} + \lambda g^1)$. For divorce to be preferred to marriage $-(1-\alpha)(1+t_w) > (4-\alpha)\lambda g^1$ so $\lambda g_l^1 \leq \frac{4t_w(1-\alpha)-3\alpha}{3\alpha} t_w$ which leads to the contradiction $\lambda g_l^1 \leq \frac{2+\alpha-2(1-\alpha)t_w}{2(1-\alpha)}$.

(ii) If both spouses are expected to invest in the public good in divorce, $\frac{1-\alpha}{\alpha} t_w < \frac{3}{4}$, the wife expects obtaining an utility of $U_{w_{(wc)}}^{2d} = \frac{3}{4}^{1-\alpha} (t_w)^\alpha$

(a) Both spouses invest in the public good in the second period in a pooling equilibrium, marriage is always preferred as by substituting $\frac{1-\alpha}{\alpha} t_w < \frac{3}{4}$ in the above divorce utility leads to the contradiction $\lambda g^1 > \frac{4t_w(1-\alpha)-3\alpha}{3\alpha}$

(b) If the husband invest and the wife does not it is straight forward. As long as $\lambda g^1 > 0$ the utility of keeping the marriage is always higher.

(c) If the wife invests in the public good and the husband does not, substituting again $\frac{1-\alpha}{\alpha} t_w < \frac{3}{4}$, leads to the contradiction $\lambda g^1 > \frac{2t_w(1-\alpha)-\alpha}{2\alpha}$

C.3 Wife Divorce Decision

The utilities of the wife if the marriage continues and she observes an investment of g_h^{1m}

$$U_w^{2m} = \alpha^\alpha (1-\alpha)^{1-\alpha}(t_w + 1 + \lambda g_h^{1m}) \quad \text{if} \quad \frac{1-\alpha}{\alpha} t_w > 1 + \lambda g_h^{1m} \tag{H1}$$
$$U_{w_{(wc)}}^{2m} = t_w^\alpha (1 + \lambda g_h^{1m})^{1-\alpha} \quad \text{Otherwise}$$

The utility of the wife if she observes an investment of g_l^{1m} and the marriage is kept are:

$$U_w^{2m} = \frac{\alpha^\alpha (1-\alpha)^{1-\alpha}(t_w + 1 + \lambda g_l^{1m})}{2-\alpha} \quad \text{if} \quad \lambda g_l^{1m} \leq \frac{1}{1-\alpha} - t_w \tag{L1}$$
$$\lambda g_l^{1m} \leq \frac{2(1-\alpha)}{\alpha} t_w - 1 \tag{L2}$$
$$U_{w_{(wc)}}^{2m} = \frac{1}{2^{1-\alpha}} t_w^\alpha (1 + \lambda g_h^1)^{1-\alpha} \quad \text{if} \quad \lambda g_l^{1m} \geq \frac{2(1-\alpha)}{\alpha} t_w - 1$$
$$U_{w_{(hc)}}^{2m} = \alpha^\alpha (1-\alpha)^{1-\alpha}(t_w + \lambda g_l^{1m}) \quad \text{if} \quad \frac{1}{1-\alpha} - t_w < \lambda g_l^{1m}$$
$$\lambda g_l^{1m} < \frac{1-\alpha}{\alpha} t_w \tag{L3}$$

and the utilities of divorce

$$U_w^{2d} = (1-\alpha)^{1-\alpha}\alpha^\alpha \frac{3(t_w+1)}{4-\alpha} \quad \text{if} \quad \frac{1-\alpha}{\alpha} t_w > \frac{3}{4} \tag{D1}$$
$$U_{w_{(wc)}}^{2d} = t_w^\alpha \frac{3}{4}^{1-\alpha} \quad \text{Otherwise}$$

High Type Proof of Proposition 3: Comparing the utilities whne the husband is a high type with those of divorce, proving that the wife is not willing to divorce the husband is straight forward.

(i) In a divorce interior solution,

(a) And interior solution in marriage, the utility of marriage is higher than the of divorce if if $g_h^1 \geq 0$, as $U_w^{2d} < U_w^m$ and $U_{w_{(wc)}}^{2d} < U_w^m$.

(b) and wife corner in marriage where the following conditions hold $1 + \lambda g_h^1 > \frac{1-\alpha}{\alpha} t_w > \frac{3}{4}$

By assuming that $U_w^d > U_{w_{(wc)}}^m$ we obtain a contradiction: when substituting $(H1)$ into $U_{w_{(wc)}}^m$, the previous inequality should hold, however, rearranging leads to a contradiction: $\frac{3}{4} < 1 + \lambda g_h^1$.

(ii) In a wife corner solution in marriage and consequently wife corner solution in divorce ($\frac{3}{4} > 1 + \lambda g_h^1$), the wife does not get divorced either

$U_{w_{(wc)}}^d > U_{w_{(wc)}}^{mc}$ implies $\frac{3}{4} < 1 + \lambda g_h^1$, Contradiction.

Low Type Proof of Proposition 5

Lets compare the utility the wife would obtain if the marriage continues and the utility expected under divorce:
In an interior solution in divorce and

(i) interior in marriage, the divorce constraint necessary for divorce to be avoided is

$$g_l^1 \geq \frac{2(1-\alpha)(t_w+1)}{\lambda(4-\alpha)} \qquad (g_{d1}^1)$$

That never holds if $\lambda < \frac{1}{2}$

(ii) wife corner in marriage, the wife does not divorce.

Proof. U_w^d *is never higher than* $U_{w_{(wc)}}^m$ *as by substituting* $(L1)$ *into* $U_{w_{(wc)}}^m$ *and rearranging leads to* $\frac{1-\alpha}{\alpha} t_w < \frac{3}{4}$ *that contradicts condition (D1).*

Again, $\lambda \geq \frac{1}{2}$ *in order for the conditions to hold*

(iii) husband corner in marriage. Divorce constraint

$$g_l^1 \geq \frac{3-(1-\alpha)t_w}{\lambda(4-\alpha)} \qquad (g_{d2}^1)$$

Again, $\lambda > \frac{1}{2}$*. By substituting condition* $(L3)$ *and setting* t_w *to its maximum value* ($t_w = 1$)*, the minimum* λ *needed is* $\frac{1}{2}$*.*

In a wife corner solution in divorce and

(i) interior in marriage, the wife always gets divorced.

Proof. Substituting $\frac{1-\alpha}{\alpha} t_w < \frac{3}{4}$ *in* $U_{w_{(wc)}}^d$*,* $U_w^m > U_{w_{(wc)}}^d$ *leads to a contradiction,* $\frac{1-\alpha}{\alpha} t_w < \frac{\lambda g_l^1 + 1}{2}$*.*

(ii) wife corner in marriage Divorce constraint:

$$\frac{1}{2\lambda} < g_l^1 \qquad (g_{d3}^1)$$

Which obviously implies that $\lambda > \frac{1}{2}$ *for divorce to be avoided as* $g_l^1 \leq 1$

(iii) husband corner in marriage, divorce always arises.

Proof. Substituting $\frac{1-\alpha}{\alpha} t_w < \frac{3}{4}$ *in* $U^d_{w_{(wc)}}$, $U^m_{w_{(hc)}} > U^d_{w_{(wc)}}$ *leads to a contradiction* $\frac{1-\alpha}{\alpha} t_w > \lambda g_l^1$.

Proof of Proposition 5: In order to prove that the investments of the husband in marriage are higher or equal to those in divorce we can just compare the first period investment in divorce that is $\frac{1}{2}$ with the different divorce constraints, that represent the minimum possible investments in marriage: g_{d1}^1, g_{d2}^1 and g_{d3}^1. And conclude that as long as $\lambda \leq 1$, $t_w \leq$ and $\alpha \leq \frac{1}{2}$ that proposition always holds.

C.4 First Period

C.4.1 High Type. Proof of Proposition 4

As the wife does never divorce a high type husband if a separating equilibrium exists, the husband always expects the marriage to be continued in the second period so, the optimisation problem if the wife does not invest in the public good in the second period is

$$\begin{aligned} \max_{g_h^1 \geq 0} \; U^{1m}_{h_{(wc)}} = \quad & (1+\lambda) g_h^1 + 1 \\ s.t \quad & \lambda g_h^1 \geq \frac{1-\alpha}{\alpha} t_w - 1 \end{aligned}$$

with Kuhn Tucker Conditions:

$$\begin{aligned} 1 + \lambda + \mu_1 - \mu_2 + \lambda \mu_3 &= 0 \\ \mu_1 g_h^1 &= 0 \\ \mu_2 (1 - g_h^1) &= 0 \\ \mu_3 \Big(\lambda g_h^1 - \frac{1-\alpha}{\alpha} t_w + 1 \Big) &= 0 \end{aligned}$$

As $1 + \lambda > 0$, $\mu_2 > 0$ so that $\mu_1 = 0$.The investment is then $g_h = 1$ and $1 + \lambda > \frac{1-\alpha}{\alpha} t_w$ holds or

the maximisation problem that the high type husband faces is the following:

$$\begin{aligned}\max_{g_h^1 \geq 0} \; U_h^{1m} = \quad & \big((1-\alpha)\lambda + 1\big)g_h^1 + (1-\alpha)(t_w+1) \\ s.t \quad & \frac{1-\alpha}{\alpha}t_w - 1 \geq \lambda g_h^1\end{aligned}$$

with Kuhn Tucker Conditions:

$$\begin{aligned}(1-\alpha)\lambda + 1 + \mu_1 - \mu_2 - \lambda\mu_3 &= 0 \\ \mu_1 g_h^1 &= 0 \\ \mu_2(1-g_h^1) &= 0 \\ \mu_3\Big(\frac{1-\alpha}{\alpha}t_w - 1 - \lambda g_h^1\Big) &= 0\end{aligned}$$

Again, as $(1-\alpha)\lambda + 1 > 0$, $\mu_2 > 0$ so that $\mu_1 = 0$. Therefore, the Marginal Utility of investing in the public good is always positive if $1+\lambda < \frac{1-\alpha}{\alpha}t_w$ ($U_{h_{(wc)}}^{1m}$ is the maximisation object, otherwise). So the high type husband invests all his income in the household public good, $g_h^1 = 1$.

C.4.2 Divorce

Low Type Husband The First Order Conditions are:

$$\begin{aligned}\frac{1}{2}\Big(\frac{1-g_l^1}{g_l^1}\Big)^{\frac{1}{2}} - \frac{1}{2}\Big(\frac{g_l^1}{1-g_l^1}\Big)^{\frac{1}{2}} &\leq 0 \\ g_l^1 &\geq 0 \\ g_l^1\big(\frac{\partial U_l^1}{\partial g_l^1}\big) &= 0\end{aligned}$$

Equilibrium choice: $g_l^{2d*} = \frac{1}{2}$

C.4.3 Separating Equilibrium: Low Type

As the objective function is continuous and concave a maximum exists and is unique. Therefore, any investment different from that choice lowers his utility.

Proof. The life-time utilities in the first period are:

$$U_l^{1i} = (1-g_l^1)^{\frac{1}{2}}(g_l^1)^{\frac{1}{2}} + \frac{(1-\alpha)(t_w+1+\lambda g_l^1)}{2-\alpha}$$
$$U_l^{1o} = (1-g_l^1)^{\frac{1}{2}}(g_l^1)^{\frac{1}{2}} + \sqrt{(1-\alpha)(t_w+\lambda g_l^1)}$$
$$U_l^{1c} = (1-g_l^1)^{\frac{1}{2}}(g_l^1)^{\frac{1}{2}} + \frac{1}{2}(1+\lambda g_l^1)$$

The Second derivative of the above utility functions is always negative:

$$-\frac{(1-2g_l^1)^2}{4\big((1-g_l^1)g_l^1\big)^{\frac{3}{2}}} - \frac{1}{\sqrt{(1-g_l^1)g_l^1}} < 0$$
$$-\frac{(1-2g_l^1)^2}{4\big((1-g_l^1)g_l^1\big)^{\frac{3}{2}}} - \frac{1}{\sqrt{(1-g_l^1)g_l^1}} - \frac{(1-\alpha)^2\lambda^2}{4(1-\alpha)(t_w+\lambda g_l^1)^{\frac{3}{2}}} < 0$$
$$-\frac{(1-2g_l^1)^2}{4\big((1-g_l^1)g_l^1\big)^{\frac{3}{2}}} - \frac{1}{\sqrt{(1-g_l^1)g_l^1}} < 0$$

The equilibrium investment choice of the husband in the first period can either be g_l^{1i}, so that the second period choice of both spouses is interior; g_l^{1c}, that leads to the wife not investing in the public good in the second period; or g_l^{1o}, implying that the husband does not invest in the public good in the second period.

C.4.4 Choice in the Second Period: Interior

g_l^{1i} is the solution to the following maximisation problem,

$$\begin{aligned} \max_{1\geq g_l^1\geq 0} \quad & U_l^{1i} = (1-g_l^1)^{\frac{1}{2}}(g_l^1)^{\frac{1}{2}} + \frac{(1-\alpha)(t_w+1+\lambda g_l^1)}{2-\alpha} \\ s.t. \quad & \frac{2(1-\alpha)}{\alpha}t_w - 1 > \lambda g_l^1 \\ & \frac{1}{1-\alpha} - t_w > \lambda g_l^1 \\ & \lambda g_l^1 \geq \frac{2(1-\alpha)(t_w+1)}{4-\alpha} \end{aligned}$$

From the divorce conditions, it is known that if the third constraint holds the wife, once she observes the investment in the first period, decides to keep the marriage. So, the Kuhn Tucker

Conditions are:

$$\frac{1}{2}\Big(\frac{1-g_l^1}{g_l^1}\Big)^{\frac{1}{2}} - \frac{1}{2}\Big(\frac{g_l^1}{1-g_l^1}\Big)^{\frac{1}{2}} + \frac{\lambda(1-\alpha)}{2-\alpha} + \mu_1 - \mu_2 - \lambda\mu_3 - \lambda\mu_4 + \lambda\mu_5 = 0$$

$$\mu_1 g_l^1 = 0$$

$$\mu_2(1-g_l^1) = 0$$

$$\lambda\mu_3\Big(\frac{2(1-\alpha)}{\alpha}t_w - 1 - \lambda g_l^1\Big) = 0$$

$$\lambda\mu_4\Big(\frac{1}{1-\alpha} - t_w - \lambda g_l^1\Big) = 0$$

$$\lambda\mu_5\Big(\lambda g_l^1 - \frac{2(1-\alpha)(t_w+1)}{4-\alpha}\Big) = 0$$

$\mu_1 = \mu_2 = 0$: a low type husband does never choose $g_l^{2d} = 1$ as $\frac{\partial U_l^{2d}}{\partial g_l^{2d}} = \infty$ or $g_l^{2d} = 0$ as $\frac{\partial U_l^{2d}}{\partial g_l^{2d}} = -\infty$. Taken this into account the relevant cases to analyse are:

1. $\mu_3 = \mu_4 = \mu_5 = 0$. *Divorce Constraint does not bind.*

$$\frac{1}{2}\Big(\frac{1-g_l^1}{g_l^1}\Big)^{\frac{1}{2}} - \frac{1}{2}\Big(\frac{g_l^1}{1-g_l^1}\Big)^{\frac{1}{2}} + \frac{\lambda(1-\alpha)}{2-\alpha} = 0 \text{ and } g_l^{1m} = \frac{1}{2} + \frac{\lambda(1-\alpha)}{2\sqrt{(2-\alpha)^2+\lambda^2(1-\alpha)^2}} \tag{L.0a}$$

Kuhn Tucker Conditions:

$$0 < \frac{1}{2} + \frac{\lambda(1-\alpha)}{2\sqrt{(2-\alpha)^2+\lambda^2(1-\alpha)^2}} < 1 \tag{L.4a}$$

$$\frac{1-\alpha}{\alpha}t_w > \frac{1}{2} + \frac{\lambda}{4} - \frac{\lambda^2(1-\alpha)}{4\sqrt{(2-\alpha)^2+\lambda^2(1-\alpha)^2}} \tag{L.1a}$$

$$t_w < \frac{-\lambda}{2} + \frac{1}{1-\alpha} + \frac{\lambda^2(1-\alpha)}{\sqrt{(2-\alpha)^2+\lambda^2(1-\alpha)^2}} \tag{L.2a}$$

$$\frac{1-\alpha}{\alpha}t_w < \frac{4-\alpha}{4\alpha}\lambda\big(1 + \frac{\lambda(1-\alpha)}{\sqrt{(2-\alpha)^2+\lambda^2(1-\alpha)^2}}\big) - 1 \tag{DIV.1}$$

Condition (L.1a) and Condition (L.2a) assure that respectively the wife and the husband choose an interior solution in the second period. If Condition ($DIV.1$) holds, the divorce constraint does not affect the equilibrium choice.

2. $\mu_3 = \mu_4 = 0; \mu_5 > 0$. *Divorce constraint binds*

$$g_{d1}^1 = \frac{2(t_w+1)(1-\alpha)}{(4-\alpha)\lambda} \text{ and } (L.0a) < 0$$

Kuhn Tucker Conditions:

$$0 < \frac{2(t_w+1)(1-\alpha)}{(4-\alpha)\lambda} < 1 \tag{L.4b}$$

$$\frac{1-\alpha}{\alpha} t_w > \frac{3}{4} \tag{L.1b}$$

$$t_w > \frac{1+2\alpha}{3(1-\alpha)} \tag{L.2b}$$

$$\Big(\frac{2+\alpha-2(1-\alpha)t_w}{2(1-\alpha)(t_w+1)}\Big)^{\frac{1}{2}} - \Big(\frac{2(1-\alpha)(t_w+1)}{2+\alpha-2(1-\alpha)t_w}\Big)^{\frac{1}{2}} + \frac{2\lambda(1-\alpha)}{2-\alpha} < 0 \tag{L.0b}$$

(L.1b) always holds, while (L.2b) implies $\alpha < \frac{1}{3}$ and ($DIV.1$) does not hold. Comparing the life-time utility of marriage if the choice is g^1_{d1} with divorce, the husband would choose g^1_{d1} if

$$t_w < \frac{4(\alpha+(1-\alpha)\sqrt{\lambda}-1)+(1+\alpha)\lambda}{2(1-\alpha)(2+2\sqrt{\lambda}+\lambda)} \tag{DIV1.a}$$

If that is not case or either conditions (L.4b) or (L.2b) do not hold the choice would be high enough that the husband in the second period would decide to choose a corner solution. So the utility to analyse is U^{1o}_l.

Proof of Proposition 7(ii) (a)

If the divorce constraint, ($DIV.1$), does not bind at t_w then either it does not bind $\forall t'_w$ or $\exists\, \tilde{t_w} > t_w : t_w > \tilde{t_w}$ for which the divorce constraint binds.

If the divorce constraint, ($DIV.1$), does not bind at t_w then either it does not bind $\forall (1-\alpha)'$ or $\exists\, (1-\alpha)'' > (1-\alpha) : (1-\alpha) > (1-\alpha)''$ for which the divorce constraint binds.

Furthemore, The difference between the utility of marriage if the divorce constraint binds and the utility of divorce ($DIV1.a$) decreases with t_w and $1-\alpha$. Therefore, *Proposition 7 (ii) (a)*, follows.

C.4.5 Choice in the Second Period: Husband Corner

If $\mu_3 > 0$ and $\mu_4 = \mu_5 = 0$ or (L.4b), (L.2b) or DIV1.a do not hold, the low type husband in the second period would choose a corner solution (Second Period Equilibrium of H in the Selfish

Husband Graph of Figure 2). The maximisation of the low type husband in the first period is:

$$\begin{aligned}
\max_{1\geq g_l^1\geq 0} \quad & U_l^{1o} = (1-g_l^1)^{\frac{1}{2}}(g_l^1)^{\frac{1}{2}} + \sqrt{(1-\alpha)(t_w+\lambda g_l^1)} \\
s.t \quad & \frac{1-\alpha}{\alpha}t_w \geq \lambda g_l^1 \\
& \lambda g_l^1 \geq \frac{1}{1-\alpha} - t_w \\
& g_l^1 \geq \frac{3-(1-\alpha)t_w}{\lambda(4-\alpha)}
\end{aligned}$$

The first constraint certifies that the wife chooses a positive investment while the second that husband chooses not to invest in the second period. The third constraint imposes the restriction that g_l^{1m} is high enough so that the wife does not divorce the husband in the second period. The Kuhn Tucker Conditions are:

$$\begin{aligned}
\frac{1}{2}\Big(\frac{1-g_l^1}{g_l^1}\Big)^{\frac{1}{2}} - \frac{1}{2}\Big(\frac{g_l^1}{1-g_l^1}\Big)^{\frac{1}{2}} + \frac{\lambda(1-\alpha)}{2\sqrt{t_w+\lambda g_l^1}} + \mu_1 + \mu_2 - \lambda\mu_7 + \lambda\mu_8 + \lambda\mu_9 &= 0 \\
\lambda\mu_1 g_l^1 &= 0 \\
\lambda\mu_2(1-g_l^1) &= 0 \\
\lambda\mu_7\Big(\frac{1-\alpha}{\alpha}t_w - \lambda g_l^1\Big) &= 0 \\
\lambda\mu_8\Big(\lambda g_l^1 - \frac{1}{1-\alpha} + t_w\Big) &= 0 \\
\lambda\mu_9\Big(g_l^1 - \frac{3-(1-\alpha)t_w}{\lambda(4-\alpha)}\Big) &= 0
\end{aligned}$$

Again, $\mu_1 = \mu_2 = 0$ as $0 < g_l^{1m} < 1$

1. $\mu_7 = \mu_8 = \mu_9 = 0$. *Divorce Constraint does not bind.*

Kuhn Tucker Conditions:

$$\frac{1}{2}\Big(\frac{1-g_l^{1o}}{g_l^{1o}}\Big)^{\frac{1}{2}} - \frac{1}{2}\Big(\frac{g_l^{1o}}{1-g_l^{1o}}\Big)^{\frac{1}{2}} + \frac{\lambda(1-\alpha)}{2\sqrt{t_w+\lambda g_l^{1o}}} = 0 \tag{L.0c}$$

$$\lambda g_l^1 > \frac{1}{1-\alpha} - t_w \tag{L.2c}$$

$$\frac{1-\alpha}{\alpha}t_w > \lambda g_l^1 \tag{L.3a}$$

$$g_l^1 > \frac{3-(1-\alpha)t_w}{\lambda(4-\alpha)} \tag{DIV2}$$

Combining conditions (L.3a) and (L.2c), $\frac{1-\alpha}{\alpha}t_w > 1$

2 $\mu_7 = \mu_8 = 0; \mu_9 > 0$. *Divorce Constraint Binds.*

$$g^1_{d2} = \frac{3-(1-\alpha)t_w}{\lambda(4-\alpha)} \text{ and } (DIV2) \text{ does not hold}$$

Kuhn Tucker Conditions:

$$0 < \frac{3-(1-\alpha)t_w}{\lambda(4-\alpha)} < 1 \tag{L.4d}$$

$$\frac{\sqrt{3}\lambda(1-\alpha)}{\sqrt{\frac{(t_w+1)(1-\alpha)}{4-\alpha}}} - \frac{3(6-2t_w(1-\alpha)-\lambda(4-\alpha)\lambda)}{\sqrt{(3-(1-\alpha)t_w)(t_w(1-\alpha)+(4-\alpha)\lambda-3)}} < 0 \tag{L.0d}$$

$$t_w > \frac{1+2\alpha}{3(1-\alpha)} \tag{L.2d}$$

$$\frac{1-\alpha}{\alpha}t_w > 1 \tag{L.3a}$$

That leads to $t_w > \frac{1}{3}$ and $\alpha < \frac{2}{5}$. Divorce does not occur if the utility of divorce is higher than that of investing g^1_{d2}:

$$\sqrt{3(4-\alpha)(1-\alpha)(1+t_w)} + \frac{1}{\lambda}\sqrt{\big(3-(1-\alpha)t_w\big)\big((1-\alpha)t_w+\lambda(4-\alpha)-3\big)} - \frac{4-\alpha}{2} - 2(1-\alpha)(1+t_w) < 0 \tag{DIV2.a}$$

Otherwise, the wife would divorce the low type husband so that he would choose $g^1_d = \frac{1}{2}$.

[O.3] If $\mu_7 = \mu_9 = 0; \mu_8 > 0$ and $\mu_4 = \mu_5 = 0; \mu_3 > 0$[29]

$$g^1_l = \frac{1}{1-\alpha} - t_w$$

Proposition 7 (ii) (b)

Using the Implicit function theorem in (L.0c), it can be obtained that $\frac{\partial g^{1o}_l}{\partial t_w} < 0$ coinciding with $\frac{\partial g^1_{d2}}{\partial t_w} < 0$. The effect of the relative income on the chances of DIV2 to bind are uncertain. However,

[29]Note that if $\mu_8 > 0$, then $(L.0c) < 0$ and the divorce condition does not affect, the maximisation problem is not the current one. Note that $(L.0c) < (L.0a)$, so that there could be a case where $(L.0a) > 0$ and $(L.0c) < 0$. If that is the situation, $g^1_l = \frac{1}{1-\alpha} - t_w$ could be chosen.

$$\frac{1}{2}\left(\frac{(\alpha-1)\lambda^2}{\sqrt{(\alpha-1)^2\lambda^2+4}} - \lambda - \frac{2}{\alpha-1}\right) > t_w$$

and

$$\frac{\lambda(1-\alpha)}{2-\alpha} - \frac{2x(\alpha-1)+\lambda(\alpha-1)+2}{2\sqrt{-(x(\alpha-1)+1)(x(\alpha-1)+\lambda(\alpha-1)+1)}}$$

$\frac{\partial g_l^{1o}}{\partial \alpha} < 0$ while $\frac{\partial g_{d2}^1}{\partial \alpha} > 0$. Therefore, the higher is the preference of the wife for the public good$1-\alpha$, the lower the probability that the constraint binds. Furthermore, the constraint does only bind if $\alpha < \frac{2}{5}$ (from constraints L.0d, L.2d, L.3a and L.4d). Therefore, for the constraint to bind, the wife cannot be extremely careless. Given that, the more careless the wife is the higher the chances of divorce to arise.

C.4.6 Choice in the Second Period: Wife Corner

If $\mu_3 = 0; \mu_4 > 0; \mu_5 = 0$, the life-time utility of the husband is U_l^{1c} and investment in the first period g_l^{1c}, meaning that the wife does not invest in the public good in the second period:

$$\begin{aligned} \max_{1 \geq g_l^1 \geq 0} \quad & U_l^{1c} = (1-g_l^1)^{\frac{1}{2}}(g_l^1)^{\frac{1}{2}} + \frac{1}{2}(1+\lambda g_l^1) \\ s.t \quad & \lambda g_l^1 \geq \frac{2(1-\alpha)}{\alpha} t_w - 1 \end{aligned}$$

where the constraint ensures the wife choosing not to invest in the public good in the second period. From the divorce conditions, we already know that the wife does not divorce the husband in the second period in such a situation.

$$\begin{aligned} \frac{1}{2}\Big(\frac{1-g_l^1}{g_l^1}\Big)^{\frac{1}{2}} - \frac{1}{2}\Big(\frac{g_l^1}{1-g_l^1}\Big)^{\frac{1}{2}} + \frac{\lambda}{2} + \mu_1 - \mu_2 + \lambda\mu_6 &= 0 \\ \lambda\mu_1 g_l^1 &= 0 \\ \lambda\mu_2(1-g_l^1) &= 0 \\ \lambda\mu_3\Big(\lambda g_l^1 - \frac{2(1-\alpha)}{\alpha} t_w + 1\Big) &= 0 \end{aligned}$$

Again, $\mu_1 = \mu_2 = 0$, so that the choice of g_l^1 is interior.

C.1 If $\mu_6 = 0$,

$$\frac{1}{2}\Big(\frac{1-g_l^1}{g_l^1}\Big)^{\frac{1}{2}} - \frac{1}{2}\Big(\frac{g_l^1}{1-g_l^1}\Big)^{\frac{1}{2}} + \frac{\lambda}{2} = 0 \tag{L.0c}$$

and the choice is:

$$g_l^{1c} = \frac{1}{2}\Big(1 + \frac{\lambda}{\sqrt{4+\lambda^2}}\Big)$$

Substituting it the Kuhn Tucker Conditions:

$$t_w < \frac{\alpha\lambda}{4(1-\alpha)}\Big(3 + \frac{\lambda}{\sqrt{4+\lambda^2}}\Big)$$

C.2 If $\mu_6 > 0$, then the above condition does not hold so that the life time utility faced by the low type husband is U_l^{1i}.[30]

If $(D1)$ does not hold, the marriage is continued if the choice of the husband is such that the wife does not invest in the second period and the maximisation problem is,

$$\begin{aligned} \max_{1\geq g_l^1\geq 0} \quad & U_l^2 = (1-g_l^1)^{\frac{1}{2}}(g_l^1)^{\frac{1}{2}} + \frac{1}{2}(1+\lambda g_l^1) \\ s.t \quad & \lambda g_l^1 \geq \frac{2(1-\alpha)}{\alpha}t_w - 1 \\ & g_l^1 \geq \frac{1}{2\lambda} \end{aligned}$$

the first constraint ensuring that the investment chosen leads to the wife not investing in the public good and the second constraint ensuring that the marriage is kept. The Kuhn Tucker conditions are

$$\begin{aligned} \frac{1}{2}\Big(\frac{1-g_l^1}{g_l^1}\Big)^{\frac{1}{2}} - \frac{1}{2}\Big(\frac{g_l^1}{1-g_l^1}\Big)^{\frac{1}{2}} + \frac{\lambda}{2} + \mu_1 - \mu_2 + \lambda\mu_{10} + \mu_{11} &= 0 \\ \lambda\mu_1 g_l^1 &= 0 \\ \lambda\mu_2(1-g_l^1) &= 0 \\ \lambda\mu_{10}\Big(\lambda g_l^1 - \frac{2(1-\alpha)}{\alpha}t_w + 1\Big) &= 0 \\ \lambda\mu_{11}\Big(g_l^1 - \frac{1}{\lambda 2}\Big) &= 0 \end{aligned}$$

Again, $\mu_1 = \mu_2 = 0$, so that the choice of g_l^1 is interior.

11. If $\mu_{10} = \mu_{11} = 0$,

$$\frac{1}{2}\Big(\frac{1-g_l^1}{g_l^1}\Big)^{\frac{1}{2}} - \frac{1}{2}\Big(\frac{g_l^1}{1-g_l^1}\Big)^{\frac{1}{2}} + \frac{\lambda}{2} = 0 \qquad \text{(L.0c)}$$

and the choice is:

[30] Note that $(L.0a) < (L.0c)$, so that if $(L.0a) > 0$ then $(L.0c) > 0$ and if $(L.0c) < 0$ then $(L.0a) < 0$, so that a choice such us $g_l^1 = \frac{2(1-\alpha)}{\lambda\alpha}t_w - \frac{1}{\lambda}$ does not occur.

$$g_l^{1c} = \frac{1}{2}\Big(1 + \frac{\lambda}{\sqrt{4+\lambda^2}}\Big)$$

Substituting it the Kuhn Tucker Conditions:

$$t_w < \frac{\alpha\lambda}{4(1-\alpha)}\Big(3 + \frac{\lambda}{\sqrt{4+\lambda^2}}\Big) \tag{L.1d}$$

$$\lambda > 0.74 \tag{DIV3}$$

12. If $\mu_{10} = 0$ and $\mu_{11} > 0$,

and the choice is:

$$g_l^{1c} = \frac{1}{\lambda 2}$$

(L.0c) < 0

and

$$\frac{\alpha(1+2\lambda)}{(1-\alpha)4\lambda} > t_w$$

which occurs if $0.53 < \lambda < 0.74$ as the utility of divorce is always lower than that of investing $g_l^{1c} = \frac{1}{\lambda 2}$

12. If $\mu_{10} > 0$ and $\mu_{11} = 0$

The cases where more than one constraint holds with equality I do not consider worth it discussing them as the lead to too specific results.