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# Three Essays on Household Formation and Dissolution

A thesis presented

by

**Jie (Jessy) Yang**

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# Abstract

**Chapter One: A Theory of Rational Marriage and Divorce.** The decisions to marry and, possibly, to divorce are amongst the most important economic decisions that individuals make during their life. The partner you marry is of great significance for determining your material prosperity. However, not all marriages are durable. Given that divorce is both common and costly, there exists a puzzling question: why do individuals get married when with high probability their marriage may not work out? Unlike much previous work in which household dissolution is explained by imperfect information, this paper develops a theory of household dynamics in a world of perfect information. Rather than relying on such considerations, the analysis in this thesis highlights the importance of public goods consideration in influencing individuals decision-making with respect to marriage and divorce. A two-period non-cooperative game is considered in which individuals allocate their labor between the outside labour market and household public good production. It is shown that individuals may rationally choose to marry even when they fully anticipate a subsequent decision to divorce. Married individuals benefit from economies of scale in household public good production, and may therefore choose to enter into a 'starter' marriage. However, if divorce is very costly, this may discourage individuals from forming a 'temporary' household.

**Chapter Two: Rational Marriage and Divorce with Remarriage.** This paper extends the first chapter by introducing the matching considerations as well

as the possibility of remarriage. In contrast to Becker (1991), it is shown that if individuals differ only in their outside market opportunities then positive assortative matching is not always optimal and negative assortative matching is not always non-optimal when traits are complements. Strikingly, individuals may choose to wait in marriage before eventually divorcing in the hope of obtaining a 'better fit'. The importance of the asset division rules upon divorce are highlighted: appropriately chosen rules not only promote stable marriage but also discourage 'temporary' marriage.

**Chapter Three: An Empirical Investigation of the Impact of Public goods and Public Policies on Household Dynamics**. This paper is an empirical investigation into the determinants of marriage and divorce. It uses the Survey of Labour Income Dynamics (SLID) Panel data set to examine the role of public goods and public policy in household formation and dissolution. Three types of public goods are identified: assets (like home ownership), children, and companionship. We look at the role of home ownership in the decisions to marry and divorce, and find that ownership prior to marriage tends to reduce the probability of marriage while ownership after marriage tends to reduce the probability of divorce. The presence of children tends, by and large, to reduce the probability of divorce. Companionship is important to maintain stability within a marriage: we found that spouses who worked in different shifts are more likely to divorce relative to others, *ceteris paribus*. Overall, we find much support for the idea that public goods serve as an

attraction for marriage; while their deterioration leads to divorce. On the policy front, we examine the impact of the 1997 Child Support Guidelines on marriage and divorce. While their effect on marriage is negligible, evidence suggests that divorce is now more likely as a result of the implementation of these guidelines.

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It has been quite a while since I began writing my thesis, and I have come to realize more and more that a thesis can never be 'finished'. A doctoral thesis marks the beginning of a commitment to life-long research. I am sure that every doctoral candidate has experienced the same things as I have: frustration, excitement but mostly feelings of reward. My first great gratitude is owed to my two supervisors: Professor Vicky Barham and Professor Rose Anne Devlin. I cannot thank them enough for their continuous support and encouragement, which have led me to this point in my research journey. I have learned from them not only how to conduct research but also how to be an excellent teacher and inquisitive researcher.

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# Contents

# Introduction

The focus of this dissertation is on the economics of marriage and divorce. Arguably, for the vast majority of the population, one of the most important economic decisions that they will take during their life is whom to marry, and then, a little later on, whether or not to remain married. The economic importance of marriage is well recognized in traditional societies, in which such institutions as arranged marriages and dowries have clearly developed to protect the economic interests of the parties. Even in the context of contemporary North American life, the life-changing consequences of marrying a rich and successful partner are well-recognized – many mothers traditionally admonished their daughters that it was "just as easy to fall in love with a rich man as a poor one" – as are the dangers of linking up with someone who is unlikely to be able to hold a stable job. Moreover, the consequences of divorce for the economic well-being of the separating spouses, and particularly for their children, have been studied at length. The fact that economists have devoted relatively little attention to the economics of marriage and divorce reflects, on the one hand, the popular view that decisions about who to marry are driven primarily by romantic considerations and are therefore not well suited to analysis in the context of the individual choice models favored by microeconomists and, on the other hand, the more pragmatic reality that these are intrinsically hard problems to treat at all satisfactorily. There is also, however, a widespread perception that public policy has a crucial role, particularly with respect to divorce, and it thus renders us much interest to develop models of household formation and dissolution which allow us to investigate the impact of changes in public policy

on these decisions. The papers in this thesis are intended to contribute towards achieving this objective.

The first chapter develops a relatively simple theoretical analysis of rational marriage and divorce. To abstract from the issues surrounding search for a suitable partner, we assume that all marriages are arranged: you can accept the partner proposed to you, or not. If you refuse the proposed partner, you remain single forever. If you agree to get married then you may, at the end of the first period, choose to get divorced. Otherwise, you remain married forever. The world ends after two periods. Marriage is by mutual consent, and divorce is automatically granted upon request of either party. In each period, members of the household (whether consisting of a single individual or a couple) must decide how to allocate their labor between production of a quasi-durable public good, or pursuing outside earnings opportunities. In the event of divorce, the quasi-durable good is divided between the partners according to an exogenously-determined (and publicly-known) sharing rule. Individuals are assumed to behave strategically, and the equilibrium concept is that of subgame perfect Nash equilibrium. The existence of public goods plays an important role in household dynamics. By forming a two-person household, individuals enjoy the economies of scale associated with public goods production. It is shown that individuals may rationally choose to marry, even when they fully anticipate a subsequent decision to seek divorce. Therefore divorce may be efficient or inefficient. The impact of changes in rules concerning asset disposition is also investigated; the analysis suggests that 50-50 asset splitting rules may effectively have their greatest impact by discouraging poorly-matched individuals from marrying, rather than by reducing the likelihood of divorce.

In the second chapter, we integrate considerations of matching into a variant of the model developed in the first chapter. We consider a $2T + 1$-period model, in which individuals can marry, divorce, and divorced individuals may choose to re-marry. Single individuals are randomly matched with other single individuals, while they know with certainty the type of partner nature has offered to them as in the first chapter. This chapter investigates how the distribution of marriages and divorces changes over time, as individuals balance off the benefits of returning to the marriage market in the hopes of being matched with a spouse who is a 'better fit' against the benefits of continued accumulation of the public good within the household. Individual decision-makings are different with or without the possibility of remarrying. Unlike the first chapter in which we show that positive assortative matchings are most likely stable, here only the one composed of individuals with high outside earning power are most likely stable. In each period marrying a rich partner is always desirable, and therefore a matching composed of low earners may be unstable. The results are contrary to what Becker (1991) argues: a positive assortative matching is stable when preferences are complements; and a negative assortative matching is stable when preferences are substitutes. Similarly a matching composed of male high earner and female low earner is different from the one composed of female high earner and male low earner. The importance of policy concerning asset disposition rules is also reinforced in this chapter.

The third chapter is an empirical investigation into the determinants of marriage and divorce, with specific emphasis on how public goods and public policies, like the Child Support Guidelines introduced in 1997 in Canada, affect these two decisions. A variety

of econometric techniques are applied in this paper, including the random effects panel logit model, and several variants of the logit procedure on various cross-sections of the data. This research uses micro-level panel data – the first Panel of Survey of Labor and Income Dynamics – and the richness of this data set makes it possible to examine how household public goods and public policies regarding the division of assets upon divorce do in fact affect marriage decisions. We find that home ownership prior to marriage tends to reduce the probability of marriage while ownership after marriage tends to reduce the probability of divorce. The existence of children tends to reduce the probability of divorce. Companionship is important to maintain stability within a marriage: we found that spouses who worked in different shifts are more likely to divorce relative to others. Overall public goods matter regarding individuals's marital decisions. On the policy front, we examine the impact of the 1997 Child Support Guidelines on marriage and divorce. While their effect on marriage is negligible, evidence suggests that divorce is now more likely as a result of the implementation of these guidelines.

The next natural application of the framework developed to date is to introduce an endogenous fertility decision. Children are a public good within a marriage but, unlike the quasi-durable public good considered in the existing framework, children are largely non-divisible, and so divorce settlements must specify how each partner will continue to support the children after the marriage has dissolved. We also would like to empirically investigate the causality between the decision to bear children and the decision to divorce.

# Chapter 1
# A Theory of Rational Marriage and Divorce

## 1.1 Introduction

Casual empiricism suggests that – as the vast majority of the population marries at some point in their lives – the lifestyle available to married couples must be one to which most citizens aspire. However, it is also true that divorce is a relatively frequent event, and is the endpoint for almost one out of three marriages. Given that divorce is a relatively costly process, the apparent eagerness with which rational individuals enter into marriage contracts must be seen as somewhat puzzling. One possible explanation for high rates of divorce is that individuals involved simply do not have adequate information about their partners – once they update their beliefs about their partner's type, they determine that they will be better off divorced rather than married. Whereas imperfect information is no doubt an important part of the story, and is certainly the key hypothesis underlying many search-based models of the marriage market (e.g., Shimer and Smith 2000, Roth 1996) this is somewhat facile as an explanation. At the dawn of the 21st century, many partners live together before marriage (which presumably allows the interested parties to obtain better information about what married life might be like), so this should reduce the likelihood of mismatches ending in divorce. Additionally, to argue that the main reason for divorce is the belated discovery that one has chosen the 'wrong' partner effectively implies that the

(often considerable!) efforts which most individuals devote to the process of identifying a suitable potential mate are relatively inefficient.

An alternative approach is to argue that rational individuals may have good reason to enter into the state of matrimony, fully realizing that their conjugal union may not last forever. Just as individuals purchase 'starter homes', with the intention of eventually trading up to something larger and more luxurious, individuals may enter into 'starter marriages'. Even if Statistics Canada data does not support the popular belief that 'two can live just as cheaply as one', there are clearly economies of scale associated with living as a couple, rather than in two separate households: in particular, within the household many assets – such as housing (and, arguably, children) – are public goods, providing consumption services to both partners. To the extent that married couples are able to accumulate these sorts of intra-household public goods faster than can single individuals, entering into marriage may be worthwhile even if one ultimately ends up divorced.[1] This intuition is the foundation for the theoretical approach developed in this paper.

The notion that the existence of shared goods within the family may provide an incentive for household formation was first stressed by Becker (1973). However, his focus in this early work was on developing the notion of comparative advantage in household production versus market activities to explain the relatively different roles traditionally associated with husbands and wives in the nuclear family. Becker's work tells a story about who does what, but not about how the partners in the household come to share their mar-

[1] Indeed, the importance of these considerations is undoubtedly one of the key reasons for which many unattached single individuals, e.g. university students, choose to share their living quarters rather than to rent studio apartments.

ried lives. In effect, therefore, this literature was concerned with intra-household resource allocation, rather than with household formation and dissolution.

More recently, this early literature has been criticized for approaching this allocation problem non-strategically. The well-known altruistic model by Becker (1973, 1974) argues that the utility function of the 'household head' depends positively on the well-being of his or her partner, providing a theoretical rationale for the assumption that the family acts as a single decision-maker – members of the household pool their incomes and maximize a neoclassical household utility function subject to the household total income constraint and the time constraints. However, Chiappori (1992) argues that modelling the household as though it were a single individual raises a number of serious difficulties. Firstly, it simply falls short with respect to the criterion of methodological individualism: microeconomic models generally treat all participants in an economy as decision-makers, which Becker's model does not do. Secondly, because the household, rather than the individual members of the household, is viewed as the decision-maker, this means that the household itself becomes a black box, and nothing can be said about its internal decision-making process.

These observations underlie the development of the more recent collective models of household resource allocation. These models emphasize the fact that families are made up of individuals with distinct tastes and experiences. The first major departure from the unitary decision-maker model was the application of Nash bargaining models to the analysis of intra-household resource allocation. Manser and Brown (1980) and McElroy and Horney (1981) argue that distribution within marriage can be seen as the outcome of a co-operative game, usually a Nash bargaining game, in which the threat point is divorce. They

assume that family members have different preferences. Bargaining power within the marriage is assumed to depend on options outside the marriage. The equilibrium distribution is determined by the feasible consumption set and a threat point that corresponds to the utility of being divorced. Relatedly, in the 'separate spheres' bargaining model by Lundberg and Pollak (1993), threat points are determined by the level of utility that each member would receive from non-cooperation (within a two-person household). Each member decides upon the level of resources to allocate toward his/her responsibilities. A non-cooperating couple differs from two independent adults insofar as both can benefit from the existence of household public goods. Lundberg and Pollak (1994) takes an approach similar to that used in their earlier joint work, but uses a non-cooperative Nash bargaining framework; however, they are unable to treat divorce. More recently, Chen and Woolley (2001) have developed non-cooperative bargaining models by including household public goods as well as caring between members. Their major conclusion is that the family's spending pattern will be influenced both by the level of income transfers, and by who in the family is the nominal recipient of transfer income. However, since divorce is excluded in their analysis one cannot tell whether a policy targeting some member of the household will result not merely in changes in the family's spending pattern, or more dramatically in the dissolution of the household. Konrad and Lommerud (2000) discuss premarital investment incentives in marriage by applying a semi-cooperative model. Their major conclusion is that there is an overinvestment in market-oriented human capital due to the strategic behaviour between family members.

A somewhat different tack is taken by Chiappori (1988a,b), who builds a fully individualized model of strategic behaviour. He develops a general, 'collective' model of household labor supply in which agents are characterized by their own preferences and household decisions are only assumed to be Pareto efficient. Under these assumptions, changes in either household nonlabour income or in the spouse's wage can only have an income effect for each "egoistic" member, unless the sharing rule is modified. Crucially, Chiappori observes that by applying the 'collective rationality' hypothesis, it is possible to derive falsifiable predictions with respect to household labour supply. Apps and Rees (1997) and Chiappori (1997) have added household production into collective models. Furthermore, Chiappori et al. (2002) examines the "distribution factors", for example the sex ratio in the marriage market and the rules of governing divorce, which affect the household members' bargaining position and thus household labor supply. One interesting empirical finding in their work is that passage of a divorce law that is favorable to women will induce husbands to transfer more to their wives.

Whereas these more recent models of intra-household resource allocation have provided considerable insight into how families allocate their resources, what is missing is an account of how these decisions relate to the more general issue of household formation and dissolution. The question which remains unanswered is whether the passage of a divorce law that is favorable to women will induce an increase of dissolved marriages or affect the proportion of the population which gets married.

In section two, below, we develop a model of rational marriage and divorce. To abstract from the issues surrounding search for a suitable partner, which have received much

attention in the literature on matching models, we assume that all marriages are arranged: the individual accepts the proposed partner, or not. The marriage matching process is exogenous. Those individuals who refuse the proposed partner remain single forever. In contrast, those individuals who decide to get married may, at the end of the first period, choose to get divorced. Otherwise, they remain married forever. The world ends after two periods. Marriage is by mutual consent, whereas divorce is automatically granted upon request of either party. In each period, members of the household (whether consisting of a single individual or a couple) must decide how to allocate their labor between production of a quasi-durable public good, or pursuing outside earnings opportunities. In the event of divorce, the quasi-durable good is divided between the partners according to an exogenously-determined (and publicly-known) sharing rule. Individuals are assumed to behave strategically, and the equilibrium concept is that of subgame perfect Nash equilibrium. Section three and four analyze the determination of equilibrium outcomes. In section five, we present simulation results. Section six concludes.

## 1.2 The Model

We consider households consisting either of unattached individuals, or couples. In each household participants consume two consumption goods: a composite private good ($x$) and a local public good ($G$). The utility function $U^i(x_i, G)$ $i = m, w$, is concave in both arguments, and is assumed to have continuous first and second order derivatives with respect to each argument.

The local public good within the household is a quasi-durable good and can be interpreted as either a physical asset, such as the family home, or a non-physical asset, such as companionship. The amount available in period $t$ is denoted by $G_t$, and is determined as a function of the depreciated stock of this good, plus additional investment in period $t$ by the member(s) of the household. More precisely,

$$G_t = \delta G_{t-1} + f(k_{mt}, k_{wt})$$

where $\delta$ denotes the discount rate, $0 < \delta < 1$, and $k_{mt}$ (respectively, $k_{wt}$) the investment of the male member (respectively, female member) of the household in production of the collective good in period $t$. We assume that $f(k_{mt}, k_{wt})$ is a well-behaved production function, concave in both arguments, and that both $f(k, 0)$ and $f(0, k) > 0$ for $k > 0$, that is, it is not essential that both members of the household invest in the production of the collective good in order to obtain a positive level of production.

In every period men and women are endowed with a fixed amount of labour, $L$, which they must allocate either to investment in the collective good within the household, or to acquiring the composite private good. Each household member decides non-cooperatively how much labour to invest in production of the collective good; the residual labour supply is then exchanged for the composite private good. Each member's outside productivity is denoted by $v_i (i = m, w)$ respectively. For simplicity, we assume that the opportunity cost of household production depends only on the family structure, and not on the identity of the spouse.[2] We assume that labour-market earnings are pooled within the household,

[2] This assumption was made to avoid dealing with issues arising around the appropriateness of the 'match' that would need to be considered if greater heterogeneity existed with respect to individuals' labour market skills or household production possibilities.

so that the total amount of the private good available for consumption in the household in period $t$ can be expressed as:

$$X_t = \upsilon_m(L - k_{mt}) + \upsilon_w(L - k_{wt})$$

When the household consists of two members, we assume that the division of $X_t$ between the members of the household is determined as the outcome of a Nash bargaining process. Since we are principally interested in the dynamics of household formation, rather than in intra-household allocation of consumption, we do not model intra-household bargaining explicitly. Instead, we observe that the result of this process will be to divide the available private good between the household members in proportion to their bargaining power. Consequently, denoting by $\theta_m$ (respectively, $\theta_w$) the proportion allocated to the male member (respectively, female member) of the household, $\theta_m + \theta_w = 1$, we can express private good consumption of both household members in period $t$ as:

$$\begin{aligned} x_{mt} &= \theta_m \left[\upsilon_m(L - k_{mt}) + \upsilon_w(L - k_{wt})\right] \\ x_{wt} &= \theta_w \left[\upsilon_m(L - k_{mt}) + \upsilon_w(L - k_{wt})\right] \end{aligned}$$

Obviously, in single person households private good consumption is trivially determined once the individual has decided how much labour to allocate to the provision of the collective good. This completes our description of intra-household resource allocation.

The principal focus of our analysis is on household formation and dissolution. We model this process as a two-period game. At the beginning of period one, each participant in the economy is offered a partner, and both potential spouses must choose whether or not to marry. Marriage requires mutual consent. If they decide to marry, then the levels

of private and collective good consumptions are determined according to the procedure outlined above. If they remain single, each participant must provide both the collective good and the private good for him or herself.

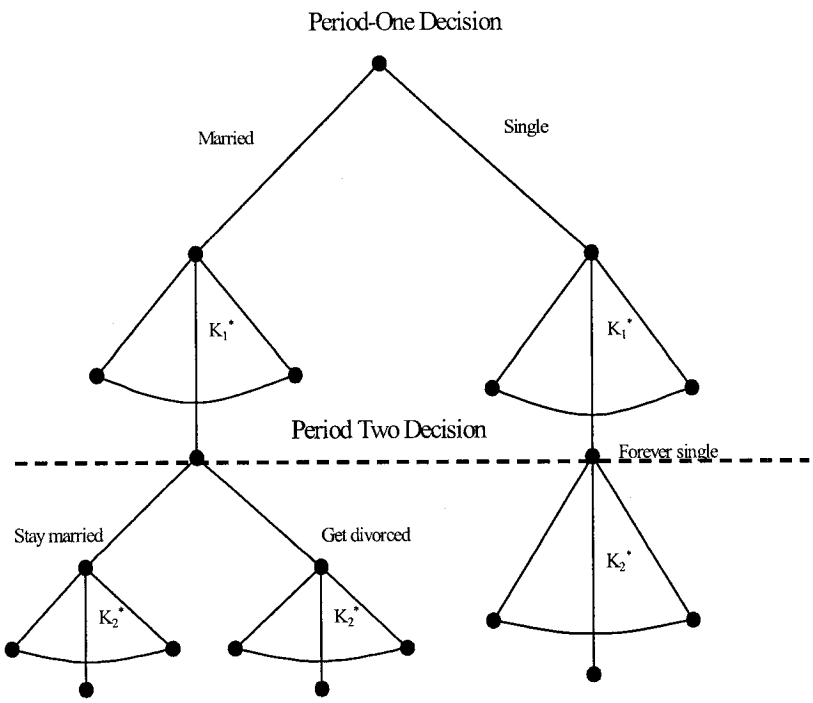
At the end of the first period, the spouses must decide whether to remain married, or whether to divorce. If they divorce, each receives a proportion $\lambda_i, i = m, w$ of the collective good, where $\lambda_m + \lambda_w \leq 1$.[3] Divorce can be imposed by either partner, and so couples remain married by mutual consent. Divorced individuals cannot remarry, but live as single individuals in period two. Given the endogenously-determined household structure at the beginning of period two, household members again decide (non-cooperatively in the case of a married couple) how much labour to allocate to production of the collective good, and how much to allocate to labour market activity. Private good consumptions are determined in the same way as in period one. The game ends after two periods. A sketch of the game tree is provided as Figure 1.

## 1.3 Equilibrium Analysis: Period Two Decision-Making

### 1.3.1 Period Two: Collective Good Production in a One Person Household

The equilibrium concept used to solve this game is that of subgame perfect Nash equilibrium. Consequently, to analyze individual decision making, we first consider period two decision making in both one person and two person households. If at the outset to period

[3] One reason for which the sum may be less than one would be if the collective good were not a physical asset.




1.Decision Tree

two the household consists of a single person, then the decision problem of this individual is very straightforward: available labour power must simply be allocated between domestic production and acquisition of the composite private good, in a utility-maximizing fashion. At the beginning of period two, the decision problem facing the individual can therefore be expressed as:

$$\begin{aligned} \max_{k_{it}} U^i &= U^i(x_{it}, G_t) \\ &= U^i(\upsilon_i(L - k_{it}), \delta G_{t-1} + f(k_{it}, 0)) \end{aligned}$$

where we have for convenience written $f(k_{it}, 0)$ rather than distinguishing between $f(k_{mt}, 0)$ and $f(0, k_{wt})$; this is perfectly correct if production is anonymous. Note that $G_{t-1}$ here denotes the existing stock of the collective good available to the single individual. In particular, if this individual is divorced, then this will be a share of the joint assets, whereas if this individual did not ever marry this existing stock will be the result of earlier period one investments. At an optimum in which positive amounts of labour are allocated to the production of the collective good it must be true that

$$-\upsilon_i U^i_x + U^i_G f_k = 0 \tag{1.1}$$

and we denote by $\widetilde{k}_{it}$ the solution to (1.1). Notice that the reference level of utility for a single person is then $U^i(\upsilon_i(L - \widetilde{k}_{it}), \delta G_{t-1} + f(\widetilde{k}_{it}, 0))$ and of course depends positively on the existing stock of the quasi-durable good.

### 1.3.2 Period Two: Collective Good Production in a Two Person Household

Recall that, within marriage, each partner takes an independent decision regarding the level of their investment in the collective good, knowing that labour market income will be pooled and divided according to pre-determined shares. Unlike the single person household, however, decision-making by spouses within marriage is strategic: the decision regarding how much effort to contribute to the production of the shared good takes into account the anticipated contribution of the partner. At the beginning of period two, the decision problem facing the individual can therefore be expressed as:

$$\begin{aligned}\max_{k_{it}} U^i &= U^i(x_{it}, G_t) \\ &= U^i\left(\theta_i\left(\upsilon_m(L-k_{mt})+\upsilon_w(L-k_{wt})\right), \delta G_{t-1} + f(k_{mt}, k_{wt})\right).\end{aligned}$$

At a Nash equilibrium at which both partners contribute to the production of the local public good it must be true that:

$$-\theta_m \upsilon_m U_x^m + U_G^m f_{k_m} = 0 \tag{1.2}$$

$$-\theta_w \upsilon_w U_x^w + U_G^w f_{k_w} = 0. \tag{1.3}$$

We denote a solution to this system of equations by the ordered pair $(\widehat{k}_{mt}, \widehat{k}_{wt})$. Note, of course, that there may be specialization in household production, i.e., all of the production of the local public good may be due to the efforts of one of the spouses.

**Proposition 1** If $\theta_m = \theta_w = \frac{1}{2}$ and same preference, $k_{mt}$ and $k_{wt}$ are perfect substitutes, then only the spouse with lower outside productivity will contribute to production of the collective good.

**Proof** According to (1.2) and (1.3) we conclude that at an interior solution it must be true that

$$\frac{\upsilon_m}{\upsilon_w} = \frac{f_{k_m}}{f_{k_w}}.$$

However, if the production function is anonymous so that $f_{k_m} = f_{k_w} \forall k_m, k_w$ this equality cannot be satisfied unless $\upsilon_m = \upsilon_w$. Consequently, the solution to the utility maximization problem for at least one partner must be a corner solution. Rewriting, we observe that

$$-\theta_m \upsilon_m U_x^m + U_G^m f_{k_m} \leq 0 \tag{1.4}$$

$$-\theta_w \upsilon_w U_x^w + U_G^w f_{k_w} \leq 0. \tag{1.5}$$

Without loss of generality, assume that $\upsilon_m > \upsilon_w$ Then it must be true that at a Nash equilibrium

$$-\theta_m \upsilon_m U_x^m + U_G^m f_{k_m} < 0 \tag{1.6}$$

$$-\theta_w \upsilon_w U_x^w + U_G^w f_{k_w} = 0. \tag{1.7}$$

That means that only the spouse with lower outside productivity contributes to the collective good production while the spouse with higher outside productivity contributes nothing. ■

It is useful to point out that, as compared to many well-known models of the voluntary provision of public goods (e.g., Bergstrom, Blume and Varian (1986)), there is typically imperfect crowding-out of individual investments in the collective good. Individual opportunity costs of contributing to household public good is not constant in our case un-

like Bergstrom, Blume and Varian's work. Totally differentiating the first-order condition for the male partner,

$$\frac{dk_{mt}}{dk_{wt}} = -\frac{(\theta_m^2 \upsilon_w \upsilon_m U_{xx}^m - \theta_m U_{xG}^m \upsilon_w f_{k_m} - \theta_m U_{xG}^m \upsilon_m f_{k_w} + U_{GG}^m f_{k_m} f_{k_w} + U_G^m f_{k_m k_w})}{(\theta_m^2 \upsilon_m^2 U_{xx}^m - 2\theta_m \upsilon_m U_{Gx}^m f_{k_m} + U_{GG}^m (f_{k_m})^2 + U_G^m f_{k_m k_m})}. \tag{1.8}$$

(An analogous expression for $\frac{dk_{wt}}{dk_{mt}}$ is straightforward to obtain.). If $U_{xG}^m, U_{xG}^w > 0$ it is easy to verify that crowding-out will be less than 100% for the spouse with the lower marginal productivity in the production of the collective good, and greater than 100% for the more productive partner. These facts have important implications for stage one choices by both partners.

**Proposition 2** A Nash equilibrium exists in the household production subgame.

**Proof** This is a straightforward application of Brouwer's fixed point theorem. See also Bergstrom, Blume and Varian (1986). ■

We do not investigate the uniqueness of the household production equilibrium (for example, if $k_m$ and $k_w$ are perfect substitutes, the level of household production will be unique, but the contribution of each partner is not); in general, both interior and corner solutions (i.e., specialization) are possible.

### 1.3.3 The Decision to Divorce

At the beginning of period 2, members of married couples must decide whether or not to remain together, or to go their separate ways. This decision is taken non-cooperatively; the household will dissolve if either spouse can do better as a single individual than as

part of a couple. When the household dissolves, each partner takes with them a share $\lambda_i$ of the local public good. In effect, when individuals form a couple they benefit from synergies in household production, but these synergies are diminished by the free-rider problem. If the level of the collective good is high enough, and the production technology for the collective good is sufficiently concave, it may be that the free rider problem is sufficiently acute so that the synergies in production of the shared good do not compensate for inefficiencies in household production, at least for one of the partners. Each partner anticipates that if he or she chooses to get divorced, their period two utility level is $U^i(\nu_i(L-\widetilde{k}_{it}), \delta\lambda_i G_{t-1} + f(\widetilde{k}_{it}, 0))$ whereas if they remain married their period two utility level is $U^i\left(\theta_i\left(\upsilon_m(L-\widehat{k}_{mt}) + \upsilon_w(L_w - \widehat{k}_{wt})\right), \delta G_{t-1} + f(\widehat{k}_{mt}, \widehat{k}_{wt})\right)$. Individual $i$ demands divorce if and only if

$$\begin{aligned} & U^i\left(\nu_i(L-\widetilde{k}_{it}), \delta\lambda_i G_{t-1} + f(\widetilde{k}_{it}, 0)\right) \\ > \; & U^i\left(\theta_i\left(\upsilon_m(L-\widehat{k}_{mt}) + \upsilon_w(L-\widehat{k}_{wt})\right), \delta G_{t-1} + f(\widehat{k}_{mt}, \widehat{k}_{wt})\right). \end{aligned} \tag{1.9}$$

To understand the factors affecting the decision to remain married or to divorce, it is interesting to compare the rate of accumulation of the local public good in one-person and two-person households. If, given an equivalent starting point, the level of the local public good increases more rapidly in the two-person than in the one-person household, there is a good chance that couples will wish to remain married.

**Proposition 3** Suppose that $\lambda_i\widetilde{G}_{t-1} = G_{t-1} = \overline{G}$, that is, the existing stock of the local public good is the same in both the single-person and the two-person household. Then

$G_t \geq \widetilde{G}_t$, that is, the level of the local public good will be (weakly) higher in the two-person household than in the one-person household.

**Proof** Within marriage, the decision problem facing the spouses is:

$$\begin{aligned}\max_{k_{it}} U^i &= U^i(x_{it}, G_t) \\ &= U^i\left(\theta_i\left(\upsilon_m(L-\widehat{k}_{mt})+\upsilon_w(L-\widehat{k}_{wt})\right), \delta G_{t-1}+f(\widehat{k}_{mt},\widehat{k}_{wt})\right).\end{aligned}$$

At an equilibrium of the household production subgame, the Kuhn-Tucker conditions prescribe that:

$$-\theta_m \upsilon_m U_x^m + U_G^m f_{k_{mt}} \leq 0 \tag{1.10}$$

$$-\theta_w \upsilon_w U_x^w + U_G^w f_{k_{wt}} \leq 0. \tag{1.11}$$

$k_{mt}^* \geq 0, k_{wt}^* \geq 0$ is the contribution that each spouse will make to the production of the household public good. The available amount of the local public good is therefore

$$G_t = \delta G_{t-1} + f(k_{mt}^*, k_{wt}^*). \tag{1.12}$$

In contrast, in a one-person household, the level of local public good production is determined by solving:

$$\begin{aligned}\max_{k_{it}} U^i &= U^i(x_{it}, \widetilde{G}_t) \\ &= U^i\left(\upsilon_i(L-\widetilde{k}_{it}), \delta\lambda_i\widetilde{G}_{t-1}+f(\widetilde{k}_{it},0)\right)\end{aligned}$$

From this we derive the first-order condition:

$$-\upsilon_m U_x^m + U_G^m f_{k_{mt}} = 0 \tag{1.13}$$

and denote by $\widetilde{k}_{mt}$ the solution to (1.13). This means that amount of the local public good available in the one-person household is:

$$\widetilde{G}_t = \delta\lambda\widetilde{G}_{t-1} + f(\widetilde{k}_{mt}, 0) \tag{1.14}$$

Suppose that in equilibrium we have $\widetilde{G}_t > G_t$ then we know that

$$U^m_{\widetilde{G}} < U^m_G$$

Moreover since the production function exhibits decreasing returns to scale,

$$\begin{aligned} \widetilde{k}_{mt} &\geq k^*_{mt} + k^*_{wt} \\ &\Rightarrow f_{\widetilde{k}_{mt}} \leq f_{k^*_{mt}} \end{aligned}$$

So we have

$$U^m_G f_{k^*_{mt}} > U^m_{\widetilde{G}} f_{\widetilde{k}_{mt}}$$

However we have

$$\begin{aligned} -\theta_m \upsilon_m U^m_x &\geq -\upsilon_m U^m_x \\ &\Rightarrow -\theta_m \upsilon_m U^m_x + U^m_G f_{k_{mt}} > -\upsilon_m U^m_x + U^m_G f_{k_{mt}} = 0. \end{aligned}$$

which is impossible. So $\widetilde{G}_t \leq G_t$ . This means that if the existing stock of the local public good in period $t-1$ is the same in both the single-person and the two-person household then the level of the local public good in period $t$ will be (weakly) higher in the two-person household than in the one-person household. ■

The above result suggests that, in many circumstances, marriage is likely to be stable. In effect, even though there is a free-rider problem in the two-person household, both partners enjoy at least as high a level of public good consumption within the marriage as

they would if they were single even if they could take with them the entirety of the shared assets.

**Proposition 4** If $\lambda_i$ increases, then person $i$ is more likely to demand divorce. ■

This follows immediately from the fact that the utility function of the divorced individual is monotonically increasing in $\lambda$.

**Proposition 5** A subgame perfect Nash equilibrium exists in the subgame beginning with the divorce/remain married subgame.

**Proof** This follows trivially from the fact that (D,D), where both partners choose to divorce, is always a Nash equilibrium: since the payoffs to both spouses are identical when only one spouse chooses divorce and when both spouses choose to divorce, neither partner can improve their payoff by deviating from (D,D), and so (D,D) is a trivial equilibrium. Note that the period two payoffs – which reflect subsequent household production decisions in single-person households – are well defined. ■

It is worthwhile stressing that the fact that (D,D) is always an equilibrium is very much driven by the assumption that there are no specific penalties associated with asking for divorce. In effect, were there a benefit attached to expressing interest in maintaining the marriage (e.g., a greater share of the marital assets), then (D,D) would disappear as a Nash equilibrium outcome.

**Proposition 6** There are at least two Nash equilibria in pure strategies in the divorce/remain married subgame.

**Proof** If (M,M) is a Nash Equilibrium, then $U^m(M,M) \geq U^m(D,M)$ and $U^w(M,M) \geq U^w(M,D)$. But since (D,D) is always a Nash Equilibrium, there are two pure strategy Nash Equilibria. If $U^m(M,M) < U^m(D,M)$, it is a dominant strategy for the man to choose divorce, but the wife's payoff is independent of her choice of strategy, and so both (D,M) and (D,D) are Nash Equilibria Likewise, if $U^w(M,M) < U^w(M,D)$ it is a dominant strategy for the wife to choose divorce, but the husband's payoff is independent of his choice of strategy, and so both (M,D) and (D,D) are Nash Equilibria. If $U^m(M,M) < U^m(D,M)$ and $U^w(M,M) < U^w(M,D)$ then (M,D), (D,M), (D,D) are all pure strategy Nash Equilibria. ■

Notice that the equilibria can be payoff -ranked. When (M,M) is a Nash equilibrium, it is Pareto superior to (D,D). Otherwise, the Nash equilibria are all payoff-equivalent. One might hope that, since the couple begins period two in a state of marital bliss, that they would not accidentally get divorced and end up at the Pareto-inferior equilibrium.

It is natural to wonder whether there is a systematic relationship between the likelihood of remaining married and the value of exogenous parameters, such as the outside earning power ($\upsilon$), the share of the private good received by each spouse ($\theta$), the productivity in household production ($f_k$), and the existing stock of the public good. Somewhat surprisingly, these relationships turn out to be extremely complex, and the results are ambiguous. To illustrate, consider two couples which differ only with respect to the wife's earning power - i.e., they have the same sharing rule, the same existing stock of the pub-

lic good, etc. The fact that the more productive wife is better able to earn more money in the labour market means that she may choose to leave her husband (allowing her to consume significantly more private goods). The husband of the non-career-oriented spouse, who enjoys a stable marriage, may end up better off, because he is able to enjoy higher public goods consumption than his divorced peer. The only clear-cut cases concern couples which are headed for divorce. In these cases, an increase in outside earning power, or in the existing stock of the public good, will generate unambiguous increases in welfare for both parties, as long as both the public and private goods are normal. In effect, even if they still ultimately split up, they both derive benefit from the higher income while the marriage lasts.

## 1.4 Period One Decision: To Get Married or Remain Single

We now consider the decisions that must be taken by the individuals in stage one, namely, whether or not to marry or remain single, and how to allocate their labour endowment between production of the collective good and the external labour market. It is immediately evident that, except for the level of $G_{t-1}$, the decision problem faced by the individual who decides to remain single in period one is similar to that of the lone person household in period two; the only significant difference is that the individual must anticipate the impact of their first period investment in production of the collective good on period two decision making. In contrast, anticipation of the future – and in particular, whether or not the partners expect to remain married or to seek divorce at the end of period one – affects the decision-making of those individuals who decide to marry. The possibility of

future divorce exacerbates first-period inefficiencies due to the non-cooperative nature of the subscription game, which in turn increases the likelihood of subsequent divorce.

### 1.4.1 Forever Single

Individuals who choose not to marry at the beginning of period one know that they will remain single for the rest of their lives. In taking their first-period decision regarding the allocation of effort between private labour market activity and production of the collective good, they will anticipate the impact of this decision on the options available to them in the second period. Using $\phi$ to denote the individual's time preference, the decision problem facing the single individual can be expressed as:

$$\begin{aligned} \max_{k_{it}} U^i &= V^i(x_{i1}, G_1) + \phi U^i(x_{i2}, \widetilde{G}_2) \\ &= V^i(\upsilon_i(L - k_{i1}), \delta G_0 + f(k_{i1}, 0)) + \\ &\quad \phi U^i(\upsilon_i(L - \widetilde{k}_{i2}), \delta G_1 + f(\widetilde{k}_{i2}, 0)) \\ \text{subject to} \quad & G_1 = \delta G_0 + f(k_{i1}, 0) \end{aligned}$$

$$\widetilde{k}_{i2} \text{ solves } -\upsilon_i U^i_x + U^i_G f_k = 0. \tag{1.15}$$

After application of the envelope theorem, the first-order condition for this individual can be expressed as:

$$-\upsilon_i V^i_x + V^i_G f_k + \phi\delta U^i_G f_k = 0. \tag{1.16}$$

We denote the level of $k_{i1}$ which solves (1.16) as $\widetilde{k}_{i1}$. Lifetime utility of the forever single individuals may be expressed as $\Delta^i(\text{single, single}) = V^i(\upsilon_i(L - \widetilde{k}_{i1}), \delta G_0 + f(\widetilde{k}_{i1}, 0)) + U^i(\upsilon_i(L - \widetilde{k}_{i2}), \delta G_1 + f(\widetilde{k}_{i2}, 0))$.

### 1.4.2 Just Married

We now consider the decision problem facing those individuals who have chosen to marry at the beginning of period one. When they take their decision regarding the effort to allocate to production of the collective good, they anticipate whether or not their marriage will survive until period two, or whether the second period will see them newly single. For the purposes of exposition, it is easiest to present separately the programs solved by the individual who anticipates sustained marital bliss and for the individual who expects their marriage to end in divorce. Thus, for the man we have that :

$$\begin{aligned}
\text{If remain married} \quad : \quad & \max_{k_{mt}} U^m = V^m(x_{m1}, G_1) + \phi U^m(x_{m2}, \widehat{G}_2) \\
= \quad & V^m \left( \begin{array}{c} \theta_m \left( (\upsilon_m(L - k_{m1}) + \upsilon_w(L - k_{w1})), \right. \\ \delta G_0 + f(k_{m1}, k_{w1}) \end{array} \right) + \\
& \phi U^m \left( \begin{array}{c} \theta_m \left( \upsilon_m(L - \widehat{k}_{m2}) + \upsilon_w(L - \widehat{k}_{w2}) \right), \\ \delta G_1 + f(\widehat{k}_{m2}, \widehat{k}_{w2}) \end{array} \right) \\
\text{subject to } G_1 \quad = \quad & \delta G_0 + f(k_{m1}, k_{w1})
\end{aligned}$$

$$\widehat{k}_{m2} \text{ solves } -\upsilon_m \theta_m U_x^m + U_G^m f_{k_m} = 0 \tag{1.17}$$

$$\widehat{k}_{w2} \text{ solves } -\upsilon_w \theta_w U_x^w + U_G^w f_{k_w} = 0. \tag{1.18}$$

After application of the envelope theorem, the first-order necessary conditions for the man and the woman are, respectively:

$$-\upsilon_m \theta_m V_x^m + V_G^m f_{k_m} + \phi \delta U_G^m f_{k_m} + \phi \frac{\partial \widehat{k}_{w2}}{\partial k_{m1}} (-\upsilon_w \theta_m U_x^m + U_G^m f_{k_w}) = 0. \tag{1.19}$$

$$-\upsilon_w \theta_w V_x^w + V_G^w f_{k_w} + \phi \delta U_G^w f_{k_w} + \phi \frac{\partial \widehat{k}_{m2}}{\partial k_{w1}} (-\upsilon_m \theta_w U_x^w + U_G^w f_{k_m}) = 0. \tag{1.20}$$

This system of equations jointly determine the subgame-perfect Nash equilibrium contributions of each partner, $\left(\widehat{\widehat{k}}_{m1}, \widehat{\widehat{k}}_{w1}\right)$ to the production of the collective good in the first period of the marriage. Lifetime utility can then be expressed as:$\Delta^i$(married,married) $=$

$$V^i\left(\theta_i\left(\upsilon_m(L-\widehat{\widehat{k}}_{m1})+\upsilon_w(L-\widehat{\widehat{k}}_{w1})\right), \delta G_0 + f(\widehat{\widehat{k}}_{m1}, \widehat{\widehat{k}}_{w1})\right) +$$
$$\phi U^i\left(\theta_i\left(\upsilon_m(L-\widehat{k}_{m2})+\upsilon_w(L-\widehat{k}_{w2})\right), \delta G_1 + f(\widehat{k}_{m2}, \widehat{k}_{w2})\right), i = m, w.$$

Similarly, if the partners anticipate that they will divorce after a single period of marriage, then the man's decision problem can be expressed as:

$$\begin{aligned}
\text{If anticipate divorce} \quad : \quad & \max_{k_{mt}} U^m = V^m(x_{m1}, G_1) + \phi U^m(x_{m2}, \widetilde{G}_2) \\
= \quad & V^m\left(\begin{array}{c}\theta_m\left(\upsilon_m(L-k_{m1})+\upsilon_w(L-k_{w1})\right), \\ \delta G_0 + f(k_{m1}, k_{w1})\end{array}\right) \\
& + \phi U^m(\upsilon_m(L-\widetilde{k}_{m2}), \delta\lambda_m G_1 + f(\widetilde{k}_{m2}, 0)) \\
\text{subject to } G_1 \quad = \quad & \delta G_0 + f(k_{m1}, k_{w1})
\end{aligned}$$

$$\widetilde{k}_{m2} \text{ solves } -\upsilon_m U_x^m + U_G^m f_k = 0.$$

After application of the envelope theorem, the first-order necessary conditions for the man and woman are, respectively,

$$-\upsilon_m\theta_m V_x^m + V_G^m f_{k_m} + \phi\delta\lambda_m U_G^m f_{k_m} = 0 \tag{1.21}$$

$$-\upsilon_w\theta_w V_x^w + V_G^w f_{k_w} + \phi\delta\lambda_w U_G^w f_{k_w} = 0. \tag{1.22}$$

We denote by $\left(\widetilde{\widehat{k}}_{m2}, \widetilde{\widehat{k}}_{w2}\right)$ the subgame-perfect Nash equilibrium levels of contribution to production of the collective good during marriage. Lifetime utility for married persons who divorce can be expressed as:

$$\Delta^i(\text{married,divorced}) = V^i\left(\begin{array}{c}\theta_i\left(\upsilon_m(L-\widetilde{\widehat{k}}_{m1})+\upsilon_w(L-\widetilde{\widehat{k}}_{w1})\right), \\ \delta G_0 + f(\widetilde{\widehat{k}}_{m1}, \widetilde{\widehat{k}}_{w1})\end{array}\right)$$

$$+\phi U^i(\upsilon_i(L-\widetilde{k}_{i2}), \delta\lambda_i G_1 + f(\widetilde{k}_{i2}, 0)), i = m, w.$$

### 1.4.3 To Wed or not to Wed

Individuals can correctly anticipate the payoffs anticipated with alternative lifestyle choices. It is rational to want to marry, anticipating divorce, if $\Delta^i$(marriage, divorced) $> \Delta^i$(single, single). Note that this condition must be satisfied for both partners if marriage is indeed to occur.

**Proposition 7** A Nash equilibrium exists.

**Proof** This follows trivially from the fact that (S,S) where both partners choose to remain single at the beginning of period one, is always a Nash equilibrium: since the payoffs to both spouses are identical when only one spouse chooses to remain single and when both spouses choose to remain single, neither partner can improve their payoff by deviating from (S,S) and so (S,S) is a trivial equilibrium. Note that (S,S) is always an equilibrium is very much driven by the assumption that marriage needs mutual consent. ■

**Proposition 8** If both partners are symmetric (i.e., same tastes, equal share of private goods and same productivity both inside and outside the household), then in a subgame perfect Nash equilibrium both partners will choose to get married , regardless of $\lambda$.

**Proof** Suppose that $\lambda_m = 1, \lambda_w = 0$. At the beginning of period two, each partner must choose whether to stay married or get divorced. Obviously since there is perfect symmetry with respect to preferences and productivity, and both partners get an equal share of the

private good, the partner who has the greatest potential benefit from divorce is the male partner, since upon divorce all accrued family assets would become the exclusive property of this partner. Consequently, if follows that if the male partner wishes to remain married, so will the female. Thus, without loss of generality, we restrict our presentation to the analysis of the male partner's decision problem. If the male partner chooses *Stay married,* then he must solve:

$$\max_{k_{mt}} U^m = U^m\left(\theta\left(\upsilon(L-\widehat{k}_{m2})+\upsilon(L-\widehat{k}_{w2})\right), \delta G_1 + f(\widehat{k}_{m2},\widehat{k}_{w2})\right).$$

We derive the first-order condition:

$$k^*_{i2} \text{ solves } -\theta\upsilon U_x + U_k f_k = 0. \tag{1.23}$$

Since everything is symmetric, we have $k^*_{m2} = k^*_{w2}$ as a Nash equilibrium solution. Thus, we may express $U^{m*}$ as

$$\begin{aligned} U^{m*} &= U^m\left(\frac{1}{2}\upsilon(L-k^*_{m2})+\frac{1}{2}\upsilon(L-k^*_{w2}), \delta G_1 + f(k^*_{m2},k^*_{w2})\right) \\ &= U^m\left(\upsilon(L-k^*_{m2}), \delta G_1 + f(k^*_{m2},k^*_{w2})\right). \end{aligned} \tag{1.24}$$

If the male partner chooses *Get divorced* then he must solve:

$$\begin{aligned} \max_{k_{mt}} U^m &= U(\upsilon(L-\widetilde{k}_{m2}), \delta\lambda_m G_1 + f(\widetilde{k}_{m2},0)) \\ &= U^m(\upsilon(L-\widetilde{k}_{m2}), \delta G_1 + f(\widetilde{k}_{m2},0)). \end{aligned} \tag{1.25}$$

We derive the first-order condition:

$$\widetilde{k}_{i2} \text{ solves } -\upsilon U_x + U_G f_k = 0.$$

Recall that the rules concerning asset disposition are such that the male partner has the same stock of the public good ($G_1$) as a divorced individual as the household has if the

couple remains married. However, observe that

$$U^m\left(\upsilon(L-k^*_{m2}),\delta G_1+f(k^*_{m2},k^*_{w2})\right)\geq U^m(\upsilon(L-\widetilde{k}_{m2}),\delta G_1+f(\widetilde{k}_{m2},0)).$$

Consequently, the male partner is better off remaining married even if he could obtain the entirety of the household public good upon divorce. The result here is not surprising since within marriage he can enjoy more of the public good without sacrificing private consumption if matched with a partner who has equal economic power. Moreover, it is straightforward to check that the female partner also prefers marriage if the male partner does not wish to divorce. Thus, there is a subgame perfect Nash equilibrium in which both partners choose to remain married in the subgame beginning with the decision 'Divorce, Remain married'.

Now we consider the marriage decision in period one. At beginning of period one, both potential partners must choose between getting married or stay single, knowing that it is a subgame perfect Nash equilibrium to remain married. The male partner must choose between 'stay single' and 'get married'.

*Stay single:*

$$\begin{aligned}\max_{k_{it}} U^i &= V^i(x_{i1},G_1)+\phi U^i(x_{i2},\widetilde{G}_2)\\ &= V^i(\upsilon_i(L-k_{i1}),\delta G_0+f(k_{i1},0))\\ &\quad +\phi U^i(\upsilon_i(L-\widetilde{k}_{i2}),\delta G_1+f(\widetilde{k}_{i2},0))\\ \text{subject to}\quad & G_1=\delta G_0+f(k_{i2},0).\end{aligned}$$

*Get married:*

$$\begin{aligned}
\text{If remain married} \quad : \quad & \max_{k_{tm}} U^m = V^m(x_{m1}, G_1) + \phi U^m(x_{m2}, \widehat{G}_2) \\
= \; & V^m \begin{pmatrix} \theta_m \left( (\upsilon_m(L - k_{m1}) + \upsilon_w(L - k_{w1})), \right. \\ \delta G_0 + f(k_{m1}, k_{w1}) \end{pmatrix} \\
& + \phi U^m \begin{pmatrix} \theta_m \left( \upsilon_m(L - \widehat{k}_{m2}) + \upsilon_w(L - \widehat{k}_{w2}) \right), \\ \delta G_1 + f(\widehat{k}_{m2}, \widehat{k}_{w2}) \end{pmatrix} \\
\text{subject to } G_1 \quad = \quad & \delta G_0 + f(k_{m1}, k_{w1}).
\end{aligned}$$

By inspection, we observe that the male partner prefers marriage to bachelorhood, given that his partner will choose to marry and will subsequently choose to remain married. It is straightforward to check that the same is true for the female partner. Consequently, there exists a subgame perfect Nash equilibrium in which both choose to marry, and neither chooses to divorce. ■

## 1.5 The Simulation Model

In order to gain greater insight into the behaviour of the model, it is useful to do some exploratory simulation analysis. We use MAPLE V to do the simulation. To ensure that all results can be clearly understood, we use an extremely transparent and simple specification of the model described above. We suppose that each family member has identical preferences, but possibly different endowments. The simulation results are developed under the hypothesis that utility functions have the following specification:

$$\begin{aligned}
\Delta^i \quad = \quad & V^i(x_{i1}, G_1) + \Phi U^i(x_{i2}, G_2) \\
= \quad & x_{i1} + \ln(G_1) + \Phi[x_{i2} + \ln(G_2)].
\end{aligned}$$

A number of important features of this specification should be noted. Firstly, utility for both individuals is linear in the private good and non-linear in the public good; the marginal utility of the partners differs by a factor of $\Phi$. Secondly, utility is separable between the private and the public good. This specification is common in the literature on the voluntary provision of public goods.

The computational strategy followed is the following: payoffs are calculated for each possible subgame. Once payoffs are calculated, determining the equilibrium path is straightforward.

### 1.5.1 Forever Single

In the case in which individuals remain single for both periods of the game the first period decision can be expressed as:

$$\begin{aligned}
\max_{k_{i1}} \Delta^i(single, single) &= V^i(\upsilon_i(L-\widehat{k}_{i1}), \delta G_0 + f(\widehat{k}_{i1}, 0)) \\
&\quad +\phi U^i(\upsilon_i(L-\widehat{k}_{i1}), \delta G_1 + f(\widehat{k}_{i2}, 0)) \\
&= x_{i1} + \ln(G_1) + \phi\left[x_{i2} + \ln(G_2)\right] \\
\text{subject to } x_{it} &= \upsilon_i(L-k_{it}) \quad i = m, w; t = 1, 2 \\
G_t &= \delta G_{t-1} + \widehat{k}_{it} \\
\widetilde{k}_{i2} \text{ solves} &\quad -\upsilon_i U_{x_{i2}} + U_{G_2} = 0.
\end{aligned}$$

At an optimum it must be true that

$$-\upsilon_i V_{x_{i1}} + V_{G_1} + \delta\phi U_{G_2} = 0.$$

Notice that the forever single payoff determines a reservation value for entering into marriage: whenever the forever single payoff exceeds the payoff under both (M,D) and (M,M), then the individual will certainly refuse the offer of marriage. If (M,M) > (S,S) >(M,D), then the individual will enter into marriage only if they do not anticipate the marriage ending in divorce.

### 1.5.2 Marital Bliss

In the case in which individuals choose to marry at the beginning of period one, and remain married for both periods of the game, the first period decision can be expressed as:

$$\begin{aligned}
\max_{k_{i1}} \Delta^i(married, married) &= V^i(x_{i1}, G_1) + \phi U^i(x_{i2}, G_2) \\
&= x_{i1} + \ln(G_1) + \phi\left[x_{i2} + \ln(G_2)\right] \\
\text{subject to } x_{it} &= \theta_i(\upsilon_m(L - k_{mt}) + \upsilon_w(L - k_{wt})) \\
i &= m, w;\ t = 1, 2 \\
G_t &= \delta G_{t-1} + k_{mt} + k_{wt} \\
k^*_{i2} &\quad \text{solves } -\upsilon_i\theta_i U_{x_{i2}} + U_{k_2} = 0, i = m, w.
\end{aligned}$$

and the first-order necessary condition for the period one decision is:

$$-\upsilon_i\theta_i V_{x_{i1}} + V_{G_1} + \phi\delta U_{G_2} = 0.$$

Note that in married couples, because of the quasi-linearity of the utility function, there is typically specialization with respect to production of the public good; the exception is when there is equal sharing of private good consumption.

### 1.5.3 Ending Up Divorced

In the case in which individuals choose to marry at the beginning of period one, and subsequently divorce, the first period decision can be expressed as:

$$\begin{aligned}
\max_{k_{i1}} \Delta^i(married, divorced) &= V^i(x_{i1}, G_1) + \phi U^i(x_{i2}, \widetilde{G}_2) \\
&= x_{i1} + \ln(G_1) + \phi\left[x_{i2} + \ln(G_2)\right] \\
\text{subject to } x_{i1} &= \theta_i(\upsilon_m(L - k_{m1}) + \upsilon_w(L - k_{w2})); i = m.w \\
x_{i2} &= \upsilon_i(L - k_{i2}) \\
G_1 &= \delta G_0 + k_{m1} + k_{w1} \\
\widetilde{G}_2 &= \lambda_i \delta G_1 + k_{i2} \\
\widetilde{k}_{i2} &\quad \text{solves } -\upsilon_i\theta_i U_{x_{i2}} + U_{G_2} = 0.
\end{aligned}$$

At an optimum it must be true that

$$-\upsilon_i\theta_i V_{x_{i1}} + V_{G_1} + \phi\delta\lambda_i U^i_{k_{i2}} = 0.$$

### 1.5.4 Simulation Results

Under the assumption of symmetric utility and production function and if $\theta_i = \frac{1}{2}$ and $\upsilon_m \neq \upsilon_w$, then there is always a corner solution within marriage. If $\upsilon_m > \upsilon_w$, then $k_m = 0$ is the Nash equilibrium whenever the household consists of two individuals. For the purposes of the simulation procedure, we focus on the equilibrium when symmetry.

With $\delta = 0.45$ ; $L = 1; \upsilon_m = 6; \upsilon_w = 4; \phi = 0.2; \lambda_m = 0.5; \theta_i = 0.5; G_0 = 0$ we have the following results:

| | $(single, single)$ | $(married, married)$ | $(married, divorced)$ |
|---|---|---|---|
| $(k_{m1}, k_{w1})$ | (0.183,0.275) | (0,0.549) | (0,0.549) |
| $(k_{m2}, k_{w2})$ | (0.0842,0.126) | (0,0.253) | (0.043,0.126) |
| $(G_1^m, G_1^w)$ | (0.183,0.275) | (0.549,0.549) | (0.549,0.549) |
| $(G_2^m, G_2^w)$ | (0.167,0.25) | (0.5,0.5) | (0.167,0.25) |
| $(\Delta^m, \Delta^{w)}$ | (3.944,2.032) | (4.061,4.061) | (4.091,3.723) |

From the above we can see that with some given parameters we have

$$\Delta^m(single, single) < \Delta^m(married, married) < \Delta^m(married, divorced)$$

$$\Delta^w(single, single) < \Delta^w(married, divorced) < \Delta^w(married, married)$$

In a subgame-perfect Nash equilibrium, persons $m$ and $w$ get married in period one, and then divorced in period two.

## 1.6 Conclusions

The analysis presented above is highly suggestive. In particular, it clearly demonstrates that it may be perfectly rational for individuals to enter into the state of matrimony, fully anticipating the fact that they will ultimately end up divorced. Unlike typical models of marriage, the analysis is not based on matching considerations (although these are obviously an issue in the real world marriage market!), but focuses instead on the public goods issues within the household. One striking observation that emerges from the simulation analysis is that a bad match (or 'starter marriage') may be worthwhile, even if the synergies in public goods production are relatively modest. This may be one factor which should be considered in trying to understand why the divorce rate is so high, and in particular has a spike after the first two years of marriage.

There is much additional work to be done. In particular, it is evidently desirable to extend the theoretical framework to include a decision to remarry, and to bear children. Children are a public good within a marriage. Unlike the quasi-durable public good considered in the existing framework, children are largely non-divisible, and so divorce settlements must specify how each partner will continue to support the children after the marriage has dissolved. We anticipate that our theoretical framework will allow us to prove that couples which choose to have children will have a different pattern of asset accumulation as compared to couples which remain single, and that most couples which ultimately divorce will in fact choose to do so either before having children, or after their children leave home.

# Chapter 2
# Rational Marriage and Divorce with Remarriage

## 2.1 Introduction

Marriage is one of the most popular — and enduring — social institutions, regardless of time, place, or culture. Most people will enter into marriage at least once during their lifetime, and there can be no doubt that the success (or failure) of this partnership will have a significant economic impact on each of the party's life experience. Popular culture takes a romantic view of marriage, suggesting that individuals enter into these relationships because of mysterious chemical effects. Whereas such fanciful notions may appear plausible to those in the halcyon days of early romance, one must also suspect that economic factors play a major role in the choice of marriage partners and in the final outcome of the marriage.[4] Inspired by Becker(1973), many economists have paid careful attention to the economics of marriage and, to a somewhat lesser extent, to the economics of divorce, seeking to analyze the marriage decision through the lens of models of rational individual decision-making. Most research focuses on intra-household resource allocation issue and recognize the ability of policymakers to target the consumption of individuals within families. However, the role of policy in household formation and dissolution has been

[4] See Rowthorn (1999)

largely overlooked. This paper is developed to explore how policy can affect not only the consumption of individuals within families but also the structure of the household.

## 2.2 Literature Review

In the economic literature on marriage, a number of fundamentally different approaches to modelling the marriage decision have been taken. The most popular approach is arguably that highlights the importance of search: men and women are assumed to be looking for a partner with the 'right' characteristics. In signalling models, an individual's type is private information, but a noisy signal provides potential partners with some insight into the likelihood of a successful match. After marriage, the quality of the match is revealed to both partners. Becker (1974) argues that people who marry relatively early are either lucky in their search for the partner or unduly pessimistic about their prospects of attracting someone better. In this framework, the reason for divorce is that the marriage was a 'mistake': had you known the characteristic of your partner, you would have chosen to remain single. He also shows that the marriage market chooses not the maximum output of any single marriage but the maximum sum of outputs over all marriages.

Acquiring better information about characteristics of potential marriage partners is obviously a big part of courtship rituals, and it seems self-evident that a number of couples eventually divorce because of information about partner characteristics learned after entering into the married state. However, given the relative prevalence of pre-marital cohabitation at the dawn of the 21st century, imperfect information seems less plausible as

the main engine of the economic analysis of household formation and dissolution than was arguably the case thirty years ago.

A second major consideration in marriage decisions, first identified by Becker (1973, 1974), are the benefits from sharing in the production of household public goods, such as shelter, meal production, and other domestic production activities. Becker's initial analysis focused on the importance of comparative advantage in household production to explain the differential involvement of men and women in market work and household activity. The mating of likes or unlikes is optimal depending on whether these traits are complements or substitutes, i.e., a superior woman raises the productivity of a superior man and vice versa.

More recently, the questions with which he was concerned – in particular, intra-household resource allocation and the relationship between this and labour market activity – have been revisited using game theoretic analytic tools. For example, Brown and Manser (1980) use the cooperative Nash bargaining model to predict how partners in the marriage will divide the surplus generated from the partnership between them. McElroy and Horney (1981) presented a detailed Nash cooperative bargaining model and generated a series of falsifiable predictions. Critics identify the neutrality of transfer targets as a major weakness of the cooperative Nash bargaining approach: whereas empirical studies have shown that it matters who receives the transfer, this was irrelevant theoretically. It does not matter if the child allowance is given to father or mother, which is inconsistent with many empirical studies. Lundberg and Pollak (1993) first tried to untangle this problem using a 'separate-sphere' Nash bargaining approach in which a noncooperative equilibrium within

marriage acts as a threat point instead of traditional divorce. They show that cash transfer can imply different equilibrium distributions in existing marriages.

Another approach developed in the serial work of Chiappori (1998, 1992, 1997) is the 'collective' model of household labor supply in which agents are characterized by their own preferences and household decisions are only assumed to be Pareto efficient. He stresses the fact that the families are made up of individuals with distinct tastes and he observes that by applying the 'collective rationality' hypothesis it is possible to derive falsifiable predictions with respect to household labour supply. In his most recent work (2002), he also examines how the rules of governing divorce, affect the household members' bargaining position and thus household labor supply. Both the 'collective' model and the cooperative-bargaining models all explicitly assume that the equilibrium distribution is Pareto optimal.

A number of other authors have re-cast the analysis of intra-household resource allocation using a non-cooperative Nash bargaining model. This literature has highlighted the importance of strategic considerations in determining spousal behaviour within the household. Lundberg and Pollak (1994) presented a simple non-cooperative model of distribution within marriage in which the equilibria are not necessarily Pareto optimal. A Cournot-Nash equilibrium of the one-shot voluntary contribution game is examined in their paper and they also argue that a Pareto equilibrium can be achieved in the repeated voluntary-contribution game if players can punish one another for deviations from cooperation. However, their work, like the divorce-bargaining model, does not show the non-neutrality of targeted transfers either. Konrad and Lommerud (2000) incorporate cooperative and non-cooperative models by assuming long-term decisions at the beginning of

marriage is noncooperative while day-to-day management of the family is reached through cooperative bargaining. They conclude that the problem of inefficient contributions to the production of public goods within the family may be worse in this blended environment than in a fully non-cooperative model. Chen and Woolley (2001) explore the income distribution within household using a non-cooperative game framework. Their findings support the fact of non-neutrality of targeted transfer. They suggest that when income transfers are determined through intra-household bargaining, the resulting resource allocation is, in general, not Pareto efficient. However, their work provides only a cursory discussion of the income effect on family resource allocation and the possibility of divorce.

Like the recent literature on intra-household resource allocation, the analysis in this paper 'unpacks' resource allocation decisions within the household by showing how these arise as the outcome of rational decision-making by individuals. However, our focus here is on the dynamics of household formation and dissolution, rather than on resource allocation within the household, and so we take a somewhat simpler approach to modelling this aspect of the economics of individual behaviour during marriage. As in Becker's work, the principal motivation for marriage will be to share in the production of public goods. We consider a finite $2T + 1$ period model, in which individuals can marry, divorce, and even re-marry. Importantly, although mismatches of partner characteristics may indeed be a factor in divorce, in this analysis there is no imperfect information: in order to benefit from economies of scale in public goods production, partners may choose to marry individuals whom they fully understand may not be suitable as 'life partners', anticipating that they will subsequently divorce and possibly remarry. Our analysis allows us to charac-

terise partnerships which are stable and those which are unstable, and generates testable predictions with respect to factors influencing the likelihood of divorce. Due to strategic behaviour of individuals, the equilibria developed in this paper are typically not Pareto efficient.

The outline of this paper is as follows. In section three, we outline our model of rational marriage, divorce and remarriage. In section four, we characterize labor allocation decisions with one-person and two-person household. Section five investigates individual marital decisions when symmetry. Section six characterizes subgame perfect Nash equilibria of the household formation and dissolution game. Section seven presents an example in order to get better understanding of the model and section eight concludes.

## 2.3 The Model

We consider households composed either of two persons or of one single person. We assume that participants in this economy are either high or low market income earners: $\left\{\overline{h}, \underline{h}\right\}, \{\overline{w}, \underline{w}\}$. Men and women are characterised by their outside earnings opportunities. We also assume that

$$\begin{aligned} \overline{h} &= \overline{w} \\ \underline{h} &= \underline{w}. \end{aligned} \tag{2.26}$$

In each household, members consume two consumption goods: a composite private good $x$ and a local public good $G$. Each individual has a fixed amount of labor, $L$, and in every period must allocate the labor between household public good production $k_i$ and the

outside labor market, $L - k_i$. In a two-person household the market income is produced and private good consumption is shared according to an exogenous Nash bargaining rule, $\theta_i$. Therefore, for individual $i$ within a two-person household at period $t$, the amount of private good consumption is

$$x_{it} = \theta_i \left[h(L - k_{ht}) + w(L - k_{wt})\right], \theta_i \in [0, 1], \theta_h + \theta_w = 1 \tag{2.27}$$

where $k_{ht}$ and $k_{wt}$ are the husband's and wife's contributions to the public good. The available private good consumption for a single person is

$$x_{it} = h(L - k_{ht}) \text{ or } x_{it} = w(L - k_{wt}) \tag{2.28}$$

The household public good, $G$, is semi-durable and the production function of $G_t$ in each period within one-person household is:

$$G_t = f(k_{ht}) \text{ for single male, or } g(k_{wt}) \text{ for single female}$$

Within a two-person family, we assume that the production of the public good is simply the sum of both members' contribution:

$$G_t = f(k_{ht}) + g(k_{wt})$$

Both $f(\cdot)$ and $g(\cdot)$ are well-behaved concave functions and therefore the production function for two-person household is also concave. At the time of marriage, the stocks of public goods of two single persons are summed up while public goods will be split between spouses upon divorce. The splitting rule will be discussed later. Instead of using a more general function $f(k_{ht}, k_{wt})$, an additively separable function implies that individuals are not intrinsically more productive at domestic work after getting married. Consequently,

it makes it less likely for people to enter into 'marriages of convenience' since gains in household production are modest. However, there are opportunities for profitable redistribution of domestic tasks. A natural expectation is that both would contribute to some degree. Another possible choice of production function is $f(k_{ht}+k_{wt})$ in which $k_{ht}$ and $k_{wt}$ are perfect substitutes. This leads to perfect crowding-out of individual contributions to the household production and generally does not lead to unique solutions in the household production subgame.

For simplicity we assume all individuals have the same preferences and the utility function is an additively separable function of $x_{it}$, $G_t$ and $G_{t-1}$. Initially each individual in this economy also has the same (possibly non-zero) stock of public good, $G_{t-1}$.

$$\begin{aligned} U_{it}^{s} &= a(x_{it}) + b(G_t) + c(G_{t-1}),\ i \in h, w \\ \text{where } s &= \text{state, } s \in \{\text{single, marry, divorce}\} \\ t &= \text{time}\ , t \in \{1, 2, 3, \cdots, 2T+1\} \end{aligned} \tag{2.29}$$

$a(\cdot), b(\cdot)$ and $c(\cdot)$ are well-behaved concave functions which means that the utility function is also concave. The utility function is also assumed to have continuous first and second order derivatives with respect to each argument. One important thing here is that $k_{it}$ – the amount individual $i$ contributes to the production of household public goods at period $t$ – is independent of the stock of public goods, $G_{t-1}$ due to the additive separability of the utility function. Consequently the new investment is independent of the stock of public goods within the household.

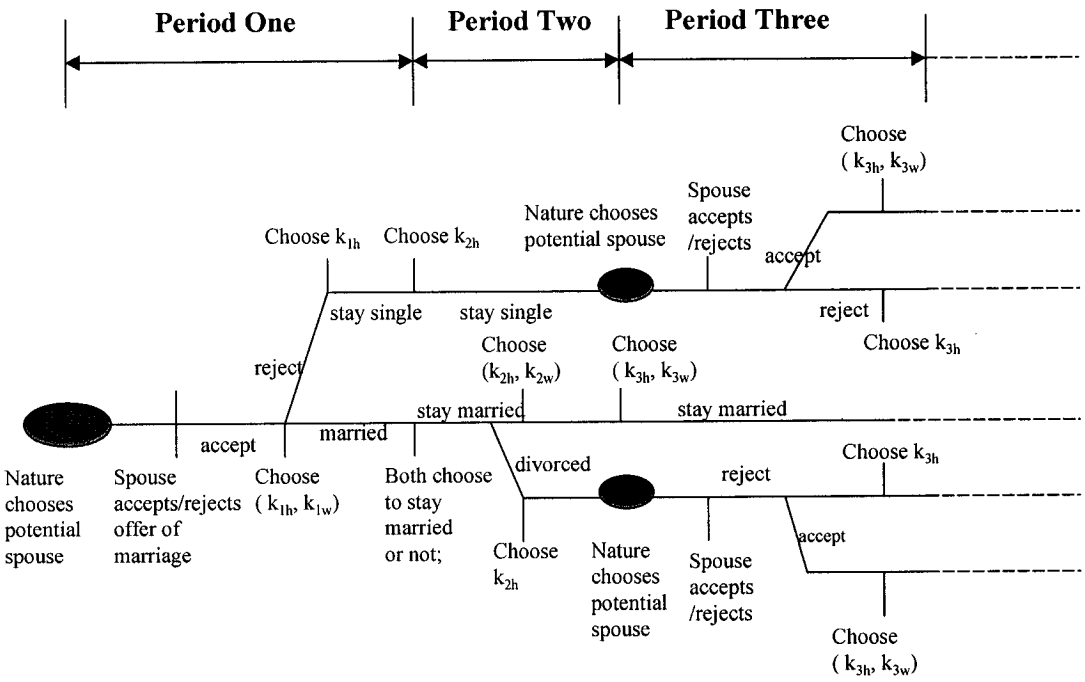
We model the process of household formation, dissolution and recomposition as a $2T + 1$ period game. In addition to the labor allocation decision individuals also make marital decisions in each period. We assume that marriage can only happen in odd periods, whereas divorce only happens in even periods. At the beginning of every odd period, $2t+1$, single individuals (including both single never married ones and divorcees) are randomly matched with other single individuals. Each potential partner must decide whether to accept the proposed marriage. Marriage requires mutual consent. Unlike the traditional searching and matching models, individuals here know with certainty the type of partner nature has offered them. If individuals reject the proposed mate, they will have to wait until the next odd period to be re-matched with another potential partner.

Subsequently, if they marry, within the two-person household, each member decides non-cooperatively and simultaneously how much labor to allocate to the production of the collective good and the market employment. The proceeds of outside labor market earnings are shared between the spouses as outlined above. If they remain single, individuals make their own decisions about labour allocation between outside market and household public good production within the one-person household.

At the beginning of every even period, $2t$, each married individual decides whether to remain married or not. The decision to divorce is unilateral or, equivalently, remaining married requires mutual consent. Upon divorce each member receives a share of the public good $\lambda_i$; the sum of $\lambda_i$ is no greater than one.[5] Again, once household structure is deter-

[5] Divorce may be costly and thus the sum of $\lambda_i$ may be less than one.

mined, individuals make the labor allocation decision as before. A timeline of decision making is provided in Figure 2.




2.Time Line

## 2.4 Labor Allocation in One-Person and Two-Person Household

In each period, in addition to the marital decision, individuals must decide how to allocate their own labor between market employment and household production. The labour

allocation decision looks the same at each period. In this section, we consider the labor allocation decision in both one-person and two-person households.

### 2.4.1 Public Good Production in a One-Person Household

Single individuals decide how to allocate their labor between outside market and household production. Their decision problem is expressed as:

$$\begin{aligned} \max_{k_{it}} U_i^S &= a(x_{it}) + b(G_t) + c(G_{t-1}) \\ \text{s.t. } x_{it} &= h(L - k_{ht}) \text{ or } x_{it} = w(L - k_{wt}) \\ G_t &= f(k_{ht}) \text{ or } g(k_{wt}) \end{aligned}$$

Therefore, as a solution to a single male's optimization problem we must have that:

$$-ha' + b'f_{k_{ht}} = 0 \tag{2.30}$$

We denote by $k_{ht}^{S*}$ the solution to (2.30); it is straightforward to derive an equivalent expression for females. We denote by $G_i^{S*}$ the equilibrium level of public goods within the one-person household. It is easy to verify that $k_{it}^{S*}$ depends only on outside earning power, $h(w)$, and is independent of the stock of the public good, $G_{t-1}$. In other word, $\frac{dk_{it}^{S*}}{dG_{t-1}}$ is equal to zero. This is a consequence of the additive separability of the utility function. Thus the analysis of the contribution game, above, thereafter applies to any stock level and therefore, to any period in which single individuals are allocating their labor between household production and labor market activity regardless of past marital history. A single person always produces the same amount of public goods in any period.

### 2.4.2 Collective Good Production in a Two-Person Household

In terms of two-person households, there are four types of matchings: $\{(\overline{h},\overline{w})\,;(\overline{h},\underline{w})\,;(\underline{h},\overline{w})\,;(\underline{h},\underline{w})\}$ and they belong to two subgroups – positive assortative matching, i.e., individuals matched with same market income earners; and negative assortative matching, i.e., individuals matched with unequal market income earners. Within marriage each partner makes a non-cooperative decision about how to allocate his/her labor between outside market and public good production within the household. The labor market income is pooled and divided according to pre-determined shares as we mentioned earlier.

At the beginning of period $2T+1$, the decision problem faced by individuals within the two-person household can be expressed as:

$$\begin{aligned}\max_{k_{it}} U_{it}^{M} &= a(x_{it}) + b(G_t) + c(G_{t-1}) \\ \text{s.t. } x_{it} &= \theta_i\left[h(L-k_{ht}) + w(L-k_{wt})\right] \\ G_t &= f(k_{ht}) + g(k_{wt}).\end{aligned}$$

At a Nash equilibrium at which both partners contribute to the production of the local public good it must be true that:

$$-\theta_h h a' + b' f_{k_{ht}} = 0 \tag{2.31}$$

$$-\theta_w w a' + b' g_{k_{wt}} = 0. \tag{2.32}$$

**Proposition 9** A Nash equilibrium exists in the household production subgame.

**Proof** This is a straightforward application of Brouwer's fixed point theorem. See also Bergstrom, Blume and Varian (1986). ■

We denote a solution to the above system of equations by the ordered pair $(k_{ht}^*, k_{wt}^*)$. In general $(k_{ht}^*, k_{wt}^*)$ will be an interior solution. However, corner solutions also arise. In particular, it can be checked that if $\theta_h \neq \theta_w$, $h = w$, or $\theta_h = \theta_w$, $h \neq w$, and if $k_{ht}$ and $k_{wt}$ are perfect substitutes, the solutions to the above program will always be a corner solution: either the person with the lesser share of private good consumption or the person with lower outside earning power specializes in household production. For example, if the production function is linear, say, $G_t = k_{ht} + k_{wt}$ in which $k_h$ is perfectly substitutable for $k_w$, an equal share of private good consumption with same outside earning power leads to a non-unique equilibrium in the household contribution subgame, although the equilibrium level of the local public good is unique. In addition, there exists a corner solution when $h \neq w$. The person with lower outside earning power will specialize in household production. However, a strictly concave production function, that is $f' \neq g'$, will exclude the possibility of a corner solution. Another special situation in which there exists a corner solution is when one member within households has no outside earning power and therefore, (s)he has to spend all of his/her labor in household public good production.

In the following we investigate the interaction between individual contributions on household public good production. Moreover we examine how the level of public goods within the two-person household is affected by exogenous parameters such as individual outside earning power $h(w)$ and the sharing rule of private good consumption $\theta_h(\theta_w)$.

First, totally differentiating equation (2.31), we observe that

$$\left[\theta_h^2 h^2 a'' + b''(f_{k_{ht}})^2 + b' f_{k_{ht}k_{ht}}\right] dk_{ht} + \left[\theta_h^2 hwa'' + b'' f_{k_{ht}} g_{k_{wt}}\right] dk_{wt} = 0.$$

or,

$$\frac{dk_{ht}}{dk_{wt}} = -\frac{\theta_h^2 hwa'' + b'' f_{k_{ht}} g_{k_{wt}}}{\theta_h^2 h^2 a'' + b''(f_{k_{ht}})^2 + b' f_{k_{ht}k_{ht}}} < 0.$$

It is easy to verify that if $f(\cdot)$ is identical to $g(\cdot)$

$$-1 \leq \frac{dk_{ht}}{dk_{wt}} < 0.$$

Crowding out is imperfect, i.e., a 1 hour increase in domestic activity by the husband will not result in a 1 hour reduction in domestic activity by the wife. This is contrast with many subscription models of public good provision, which often rely on quasi-linear utility function. We also observe that $\frac{dk_{ht}}{dk_{wt}} = -1$ whenever $f(\cdot)$ is not strictly concave, i.e., $f_{kk}$ equals zero. There is a perfect crowding out.

If we totally differentiate equation (2.31) and (2.32), we observe that

$$\frac{dk_h}{dh} = \frac{\begin{array}{c}\left(\theta_h a' + \theta_h^2 h a''(L-k_h)\right) * \left(\theta_w^2 w^2 a'' + b''(g_{k_w})^2 + b' g_{k_w k_w}\right) - \\ \left(\theta_w^2 w a''(L-k_h)\right) * \left(\theta_h^2 hwa'' + b'' f_{k_h} g_{k_w}\right)\end{array}}{|H|} \gtrless 0.$$

and

$$\frac{dk_h}{d\theta_h} = \frac{\begin{array}{c}\left(ha' + \theta_h h a'' X\right) * \left(\theta_w^2 w^2 a'' + b''(g_{k_w})^2 + b' g_{k_w k_w}\right) \\ + \left(wa' + \theta_w w a'' X\right) * \left(\theta_h^2 hwa'' + b'' f_{k_h} g_{k_w}\right)\end{array}}{|H|} \gtrless 0.$$

In addition we find that

$$\begin{aligned}\frac{dG^*}{dh} &= f_{k_h}\frac{dk_h}{dh} + g_{k_w}\frac{dk_w}{dh} \\ &= \frac{\theta_h h - \theta_w w}{\theta_w w} g_{k_w}\frac{dk_w}{dh} \gtrless 0.\end{aligned}$$

Similarly

$$\frac{dG^*}{d\theta_h} = \frac{\theta_h h - \theta_w w}{\theta_w w} g_{k_w} \frac{dk_w}{d\theta_h} \gtrless 0.$$

In general the sign of $\frac{dk_h}{dh}$ is undetermined. If $a'' = 0$,[6] it is easy to verify that $\frac{dk_h^*}{dh} < 0$ and $\frac{dk_w^*}{dh} > 0$. Similarly, we can conclude that $\frac{dk_h^*}{dw} > 0$ while $\frac{dk_w^*}{dw} < 0$ under the same assumptions. We also observe that if $a'' = 0$, with positive assortative matchings then $\frac{dG^*}{dh} \geq 0$ whenever $\theta_h \geq \theta_w$. How much individuals contribute to the production of the household public good is negatively correlated with their own earning power while positively correlated with their spouse earning power. A promotion for your partner will decrease his or her contribution to the household production while increasing your own effect. In the meantime, $G^*$ is increasing due to the imperfect crowding-out effect.

Similarly, when $a'' = 0$, it is easy to verify that $\frac{dk_h}{d\theta_h} < 0$ and $\frac{dk_w}{d\theta_h} > 0$ and that $\frac{dG^*}{d\theta_h} > 0$ when $\theta_h > \theta_w$ and $h = w$. When the sharing rule of private good consumption becomes favorable for one member within household, (s)he will contribute less to household production while the other member will contribute more. Again, due to the imperfect crowding-out effect, $\frac{dk_{ht}}{dk_{wt}} \geq -1$, the level of public good will be increasing while the total amount of the private good available for consumption is decreasing. In that case, positively matched household invests more in the collective good than a household where the private good consumption is equally shared.

**Proposition 10** Suppose $f(\cdot)$ is identical to $g(\cdot)$, then the level of the local public good in period $2t$ will be higher in two-person household than in a one-person household.

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[6] For example, a quasi-linear utility function.

**Proof** Within marriage, the decision problem facing the spouses is:

$$\max_{k_{it}} U^i = a(x_{it}) + b(G_t) + c(G_{t-1})$$

At an equilibrium of the household production subgame, the F.O.C. conditions prescribe as equations (2.31) and (2.32). Denote by $(k^*_{ht}, k^*_{wt})$ the contribution that each spouse will make to the production of the household public good. The available amount of the local public good is therefore

$$G_t = f(k^*_{ht}) + f(k^*_{wt}). \tag{2.33}$$

In contrast, in one-person household, the level of local public good production is determined by solving:

$$\max_{k_{it}} U^i = a(x_{it}) + b(\widetilde{G}_t) + c(G_{t-1})$$

The first-order condition for male prescribes as equation (2.30). Denote by $\widetilde{k}_{ht}$ the solution to equation (2.30). This means that amount of the local public good available in the one-person household is:

$$\widetilde{G}_t = f(\widetilde{k}_{ht}) \tag{2.34}$$

Suppose that in equilibrium we have $\widetilde{G}_t > G_t$ then we know that

$$b'(\widetilde{G}_t) < b'(G_t)$$

Consequently

$$\begin{aligned} \widetilde{k}_{ht} &> k^*_{ht} \\ &\Rightarrow f_{\widetilde{k}_{ht}} < f_{k^*_{ht}}. \end{aligned}$$

So we have

$$b'(G_t) f_{k^*_{ht}} > b'(\widetilde{G}_t) f_{\widetilde{k}_{ht}}$$

However we have

$$\begin{aligned} -\theta_h h a' &\geq -h a' \\ &\Rightarrow -\theta_h h a' + b'(G_t) f_{k^*_{ht}} > -h a' + b'(\widetilde{G}_t) f_{\widetilde{k}_{ht}} = 0. \end{aligned}$$

which is impossible. So $\widetilde{G}_t < G_t$ . This means that if with a identical production function of male and female, the level of the local public good will be higher in the two-person household than in the one-person household. ■

The above results suggest that in many circumstances, marriage is desirable. Within two-person households both partners enjoy at least as high a level of public good consumption as they would if they were single. Married people benefit from the economies of scale associated with household public good production.

## Household Production with Positive Assortative Matching

We refer positive assortative matching as a situation in which an individual is matched with another individual with same outside earning power. There are two kinds of positive assortative matchings: $\left\{\left(\overline{h}, \overline{w}\right); \left(\underline{h}, \underline{w}\right)\right\}$ and from now on we will call them high-high and low-low matchings respectively.

**Proposition 11** Assume that $f(\cdot)$ is identical to $g(\cdot)$, and that both are strictly concave.[7] The spouse with the lesser share of private good consumption contributes more to household production within a positive matched household.

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[7] Strict concavity gurantees a unique solution to equation 2.31 and 2.32.

**Proof** At any interior solution it requires that

$$\frac{\theta_h}{\theta_w} = \frac{f_{k_{ht}}}{g_{k_{wt}}}$$

If $\theta_h = \theta_w$, $f(\cdot)$ is same as $g(\cdot)$ and both are strictly concave, at the equilibrium

$$k^*_{ht} = k^*_{wt}$$

If $\theta_h \neq \theta_w$, say, $\theta_h > \theta_w$, at the optimum:

$$k^*_{ht} < k^*_{wt}$$

■

An unequal share of private good consumption will lead to an equilibrium in which the person enjoying more private goods consumption has to work more in the outside labor market. Otherwise, both partners contribute the same to household production within a positive matched household.

**Proposition 12** Assume that $\theta_h = \theta_w = 0.5$ and $f(\cdot)$ is identical to $g(\cdot)$, individuals contribute no more household labor than if they are single.

**Proof** From above we observe that $k^*_{ht} = k^*_{wt}$ when $\theta_h = \theta_w = 0.5$. Therefore the amount of his/her private good consumption is:

$$\begin{aligned} x^*_{ht} &= x^*_{wt} = 0.5\left[h(L - k^*_{ht}) + w(L - k^*_{wt})\right] \\ &= h(L - k^*_{ht}) = w(L - k^*_{wt}) \end{aligned}$$

Suppose that individuals contribute more than if they are single, that is, $k^*_{ht} > k^{S*}_{ht}$. We can derive that $x^*_{ht} < x^{S*}_{ht}$ which means $x_{ht}$ must be an inferior good since it is decreasing when

income is increasing within marriage. It violates our assumption about the normality of both private good and household public good. Therefore individuals contribute no more labor to the household public good production than if they are single. ■

**Corollary 1** Assume that $\theta_h = \theta_w = 0.5$ and $f(\cdot)$ is identical to $g(\cdot)$. Then the level of public goods within positive assortative matchings, $G_t^*$ is more than $G_t^{S*}$ but no more than $2G_t^{S*}$. ■

The proof is a straightforward implication of Proposition 12 and thus is skipped. When the private good consumption is shared equally between members within positive assortative matchings, the amount of labor individuals contribute to household public good production is no more than that if they are single. Therefore the amount of private goods each member consumes is increasing as well as the amount of public goods. Individuals are certainly better off within two-person household than they are single.

## Household Production with Negative Assortative Matching

In contrast to positive assortative matchings, a matching composed of individuals with unequal outside earning power is referred to as negative assortative matching. There are also two kinds of negative assortative matchings: $\left\{\left(\overline{h}, \underline{w}\right); \left(\underline{h}, \overline{w}\right)\right\}$. We analyse only $\left(\overline{h}, \underline{w}\right)$ matching since it is symmetric to $\left(\underline{h}, \overline{w}\right)$. Due to asymmetric earning power with negative assortative matching, individuals have different opportunity costs of producing household public goods. Therefore negative assortative matchings differ from positive assortative matchings in household production.

**Proposition 13** If $\theta_{\overline{h}} = \theta_{\underline{w}}$ and $f(\cdot)$ is identical to $g(\cdot)$ which is strictly concave, the husband, who has higher outside earning power contributes less to household production than wife does.

**Proof** It must be true that at the Nash equilibrium:

$$-\theta_{\overline{h}}\overline{h}a' + b'f_{k_{\overline{h}t}} = 0$$

$$-\theta_{\underline{w}}\underline{w}a' + b'g_{k_{\underline{w}t}} = 0.$$

At an optimum

$$\frac{\overline{h}}{\underline{w}} = \frac{f_{k_{\overline{h}t}}}{g_{k_{\underline{w}t}}}$$

$$\overline{h} > \underline{w} \Rightarrow f_{k_{\overline{h}t}} > g_{k_{\underline{w}t}}$$

Moreover when $f(\cdot)$ is identical to $g(\cdot)$, we have $k^*_{\overline{h}t} < k^*_{\underline{w}t}$ in the equilibrium. The person with higher outside earning power contributes less to the household production than his partner. In addition, the ratio of marginal productivities of household production is equal to the ratio of outside earning powers. ■

The above discussion demonstrates that for a given sharing rule, how much to contribute to the production of the public good by each partner in the household depends on both marital status and the ratio of outside earning powers of the partners while it does not depend on the stock of public goods. Thus the equilibrium outcomes of the contribution game should apply to any period of the game. In general, if private good consumptions are equally shared, individuals with relatively lower economic power will contribute more to the household production due to relatively low opportunity cost while individuals with relatively higher economic power will spend more time in the outside labor market then

get more labor earnings in exchange for family private good consumptions. It is similar to what Becker (1991) analyzed about comparative advantage in household production. However, our analysis also shows that an unequal share of private good consumption can affect the comparative advantage in household production: the partner with lower opportunity cost does not necessarily contribute more to household production.

We observe that an unequal share of private good consumption within positively assortatively matched household is similar in effect to an equal share of private good consumption within negatively assortatively matched household; and therefore from now on we focus on the case of the equal sharing rule. We recognize that in reality there is a question about who is better for housework: the woman or the man. There exists a natural division of labor with some extent: women are presumably more suited to caring for a baby. However, from now on we assume that $f(\cdot)$ is identical to $g(\cdot)$.

## 2.5 Marital Decisions When partners are Symmetric

The equilibrium concept used to solve the game is that of subgame perfect Nash equilibrium. Consequently, to analyze individual decision making, we solve through backwards induction. Recall that we assume marriage happens only in odd periods and divorce happens only in even periods. That is, only single people make marital decisions in odd periods whereas only married people make marital decisions in even periods. The game ends in period $2T+1$. For simplicity, it is assumed that individuals only get married when their payoff is higher if married than their payoff if they were single.

### 2.5.1 Period $2T+1$: The Decision to Remarry or Marry

At the beginning of period $2T+1$, a divorced person must decide whether or not to remarry while a single person decides whether or not to marry. Regardless of marital history, a single never married person is exactly same as a divorced person with same outside earning power. The reason for that is at period $2T$, both a single never married person and a divorced person produce same amount of public goods, $G_{2T}^{S*}$. Having same amount of $G_{2T}^{S*}$ will make a divorcee exactly same as a single never married person in the marriage market at period $2T+1$. Therefore single people are only characterised by their outside earning powers. Notice that period $2T+1$ is different from any previous odd periods since there is no future possibilities.

**Proposition 14** Individual $i$ benefits from an increase in the earning power of his/her partner in period $t$.

**Proof** Without loss of generality, we investigate how the husband's utility in period $t$ is affected by an increase in the wife's outside earning power, that is:

$$\begin{aligned}\frac{\partial U_h^M}{\partial w} &= a'\frac{\partial X_h}{\partial w} + b'\frac{\partial G_t}{\partial w} \\ &= \frac{dk_h}{dw}[-\theta_h a' h + b' f_{k_h}] + \frac{dk_w}{dw}[-\theta_h a' w + b' f_{k_w}] + \theta_h a'(L-k_w).\end{aligned}$$

Observe that $-\theta_h a' h + b' f_{k_h}$ is the equation (2.31) and $-\theta_h a' w + b' f_{k_w}$ is same as the equation (2.32) when $\theta_h = \theta_w$. Therefore after application of the envelope theorem, we conclude that

$$\frac{\partial U_h^M}{\partial w} = \theta_h a'(L-k_w) \geq 0,\ k_w \in [0, L]$$

That is, an increase in the earning power of wife is Pareto-improving for the husband. ■

Similarly we can conclude that an increase in the husband's outside earning power is Pareto improving for the wife in period $t$ as well: marrying a rich person is certainly better off. In general the effect of an increase in individual earning power on his/her partners welfare is ambiguous when $\theta_h \neq \theta_w$.[8]

**Proposition 15** In period $2T+1$, positive assortative matching leads to marriage.

**Proof** According to Proposition 12, $k^*_{wt} = k^*_{ht} \leq k^{S*}_{ht}$ and $G^*_t > G^{S*}_t$. Therefore, being married is Pareto improving for both members, and so that a positive assortative matching will lead both partners to accept the offered marriage. ■

An equal division of private goods brings each partner no less private good consumption than when they are single and also provides more public goods. Both partners are better off if married and so positive assortative matches lead to marriage in period $2T+1$.

**Proposition 16** When positively assortative matchings lead to marriage in equilibrium, then for a given $\overline{h}$ there exists $w$ in the interval $[0, \overline{h}]$ such that negatively assortative matching leads to marriage in the Nash equilibrium only if $w \geq \underline{w}'$.

**Proof** When $w = 0$ the wife invests all of her labor in household public good production. Therefore, $h$'s payoff within marriage is:

$$U^M_h = a(X_h) + b(G_t) + c(G_{t-1})$$

---

[8] Recall we have discussed a special case in which $\frac{dk_w}{dw} < 0$ if $a'' = 0$, and so that $\frac{\partial U^M_h}{\partial w} \geq 0$ if $\theta_h > \theta_w$.

$$\text{where } X_h = \frac{1}{2}hL; G_t = f(L)$$

However, he may choose to reject a partner who can earn nothing from the outside labor market and his payoff if staying single (or his reservation payoff) is:

$$U_h^S = a(X_h) + b(G_t) + c(G_{t-1})$$
$$\text{where } X_h = h(L - k_h^{S*}); G_t = f(k_h^{S*})$$

If $U_h^M \geq U_h^S$, the male would always prefers to marry whomever is offered: being married is a dominant strategy in equilibrium. If $U_h^M < U_h^S$, he will reject a partner with no outside earning power. However, from Proposition (14) we have $\frac{\partial U_h^M}{\partial w} \geq 0$ and we also know that $\overline{h}$ would marry $\overline{w}$. Thus there must exist a $w$ in the interval $[0, \overline{h}]$ such that negative assortative matching leads to marriage in Nash equilibrium only if $w \geq \underline{w}'$. ■

A high earner may reject a low earner when the gap in outside earning power is too big. The benefits from sharing public goods cannot compensate for the loss in private good consumption. From now on we use $\Delta_i(i,j)$ to denote the net gain of individual $i$ being married with $j$, that is:

$$\Delta_i(i,j) = U_i^M(i,j) - U_i^S$$

From Proposition 14, we conclude

$$\Delta_{\overline{h}}(\overline{h}, \overline{w}) \geq \Delta_{\overline{h}}(\overline{h}, \underline{w})$$
$$\text{and } \Delta_{\underline{w}}(\overline{h}, \underline{w}) \geq \Delta_{\underline{w}}(\underline{h}, \underline{w}).$$

Individuals are always better off marrying a rich partner than marrying a poor one. In addition, we observe that rich people have higher utility levels than poor people since

$\frac{\partial U_i^S}{\partial i} > 0$. Therefore, given $\theta_h = \theta_w = 0.5$, the following must be true as well:

$$\begin{aligned} \Delta_{\underline{w}}(\overline{h}, \underline{w}) &\geq \Delta_{\overline{h}}(\overline{h}, \underline{w}) \\ \text{and } \Delta_{\underline{h}}(\underline{h}, \overline{w}) &\geq \Delta_{\overline{w}}(\underline{h}, \overline{w}). \end{aligned}$$

If each party gets an equal share of private good consumption within marriage, the poorer one gains most from a negative assortative matching. Therefore a necessary condition for negative assortative matching to lead to marriage is that the rich partner be willing to marry.

### 2.5.2 Period $2T$ Decision: To Remain Married or Not

We now consider the decisions that must be taken by individuals at the beginning of period $2T$. A single person, including single, never married and divorced persons, will stay single during this period since marriage only takes place in odd periods. They only need to decide how to allocate their own labor between outside market and household production. Unlike single people, married individuals must decide whether to remain married, as well as how to allocate their labor. If they choose to divorce, each member receives a share, $\lambda_i$, of the household public good and they are offered a mate in next period, period $2T + 1$. The sum of $\lambda_i$ is no greater than one.

Since a divorcee is reoffered a mate with certainty in period $2T + 1$, married individuals choose to divorce if and only if their expected payoff upon divorce is higher than their payoff if staying married. Recall that we assume potential partners are randomly offered by nature. We use $\pi_t^{\overline{w}}$ and $\pi_t^{\underline{w}}$ to denote $\overline{h}$ or $\underline{h}$'s probabilities of meeting $\overline{w}$ and $\underline{w}$ in period $t$ respectively, where the sum of $\pi_t^{\overline{w}}$ and $\pi_t^{\underline{w}}$ equals one. Similarly, we use $\pi_t^{\overline{h}}$ and $\pi_t^{\underline{h}}$

to denote $\overline{w}$ or $\underline{w}$'s probabilities of meeting $\overline{h}$ and $\underline{h}$ in period $t$ respectively, and the sum of $\pi_t^{\overline{h}}$ and $\pi_t^{\underline{h}}$ equals one. The probabilities here are assumed to be exogenous and individuals have perfect information about these probabilities.

Recall that the decision to divorce is unilateral: marriage will be dissolved whenever the expected payoff of one member upon divorce exceeds his or her payoff from staying married. Consequently, divorce may be efficient – when both partners prefer divorce or inefficient – when only one partner gains and the other loses upon divorce.

**Proposition 17** When $\lambda_h$ increases, it is more likely that $h$ will divorce $w$.

**Proof** Whether or not $h$ chooses to divorce depends on the comparison of his payoffs between staying married and getting divorced. Denoting the discount factor of the utility by $\delta$,[9] his payoff from staying married is:

$$\sum_{t=2T}^{2T+1} U_h^{MM} = U_{h,2T}^M + \delta U_{h,2T+1}^M$$

His maximal payoff upon divorce is:

$$\sum_{t=2T}^{2T+1} U_h^{D*} = U_{h,2T}^D + \delta E U_{h,2T+1}$$

Observe that his payoff in period $2T+1$ is independent of $\lambda_h$. Therefore

$$\begin{aligned} \frac{\partial \sum_{t=2T}^{2T+1} (U_h^{MM} - U_h^{D*})}{\partial \lambda_h} &= \frac{\partial \left(U_{h,2T}^M - U_{h,2T}^D\right)}{\partial \lambda_h} \\ &= -c' G^* \leq 0 \end{aligned}$$

Higher share he receives upon divorce, more likely he would ask for divorce. ■

[9] Assume $\delta \leq 1$

The splitting rule of household public goods upon divorce, $\lambda_i$, is normally regulated by government's policies and thus can be viewed as exogenous. Here we show that this policy variable affects individual decision to divorce and later after we will show it affects individual decision to marry. Now we analyse individual decisions in period $2T$ by different households.

### $(\overline{h}, \overline{w})$ marriage

At the beginning of period $2T$, both $\overline{h}$ and $\overline{w}$ decide whether to stay married or not. If both prefer staying married, they will stay married until the game ends after period $2T+1$. If they choose to divorce, both $\overline{h}$ and $\overline{w}$ will be re-matched with a 'new' partner at the beginning of period $2T+1$.

**Proposition 18** Staying married is a dominant strategy for both $\overline{h}$ and $\overline{w}$ if $\lambda = 0.5$.

**Proof** From Proposition 12, we know that $k^*_{ht} = k^*_{wt} \leq k^{S*}$. Thus

$$\begin{aligned} G^* &= 2f(k^*) \leq 2G^{S*} \\ &\Rightarrow c(G^{S*}) - c(\lambda_h G^*) \geq 0. \end{aligned}$$

It is easy to verify that

$$\sum_{t=2T}^{2T+1} (U^{MM}_{\overline{h}} - U^{D*}_{\overline{h}}) > 0.$$

Thus staying married is a dominant strategy for $\overline{h}$ and by the same argument this must also be true for $\overline{w}$. ■

Observe that $\overline{h}/\overline{w}$ can not marry a 'better fit' at period $2T+1$, and therefore if they divorce it must be because one person acquires more than half of public goods at the cost of his/her spouse. In this case divorce is always inefficient since one gets more than half of the public goods, whereas the other gets a lesser share.

## $(\underline{h}, \underline{w})$ Marriage

At the beginning of period $2T$, both $\underline{h}$ and $\underline{w}$ decide whether to stay married or not. Unlike the other positive assortative matching $(\overline{h}, \overline{w})$, there exists a 'better fit' for $(\underline{h}, \underline{w})$ if they divorce in period $2T$: if $(\underline{h}, \underline{w})$ is dissolved, either might be matched with a high earner in period $2T+1$. Consequently the divorce decision of low-low pairs is different from that of high-high couples. It is easy to show that $(\underline{h}, \underline{w})$ is stable if a high-low matching does not lead to marriage in subsequent period $2T+1$. Thus we consider only the situation where in period $2T+1$ a high-low matching leads to marriage hereafter.

**Proposition 19** For given $\lambda_i$, low-low matching is stable only if the probability of marrying a high ability spouse subsequent to divorce is low enough.

**Proof** Without loss of generality we consider $\underline{h}'s$ decision. His payoff from staying married with $\underline{w}$ is:

$$\sum_{t=2T}^{2T+1} U_{\underline{h}}^{MM} = U_{\underline{h},2T}^{M} + \delta U_{\underline{h},2T+1}^{M}$$

His expected payoff upon divorce at period $2T$ is:

$$\begin{aligned} \sum_{t=2T}^{2T+1} U_{\underline{h}}^{D*} &= U_{\underline{h},2T}^{D} + \delta E U_{\underline{h},2T+1} \\ &= U_{\underline{h},2T}^{D} + \delta[\pi_{2T+1}^{\overline{w}} U_{\underline{h},2T+1}^{M} + \pi_{2T+1}^{\underline{w}} U_{\underline{h},2T+1}^{M}]. \end{aligned}$$

In period $2T$ $(\underline{h}, \underline{w})$ is dissolved if and only if

$$\sum_{t=2T}^{2T+1} \left(U_{\underline{h}}^{MM} - U_{\underline{h}}^{D*}\right) < 0$$

We can conclude that

$$\begin{aligned} \frac{\partial \sum_{t=2T}^{2T+1} \left(U_{\underline{h}}^{MM} - U_{\underline{h}}^{D*}\right)}{\partial \pi_{2T+1}^{\overline{w}}} &= \delta \frac{\partial \left(U_{\underline{h},2T+1}^{M} - EU_{\underline{h},2T+1}\right)}{\partial \pi_{2T+1}^{\overline{w}}} \\ &= \delta \left[\Delta_{\underline{h}}(\underline{h}, \underline{w}) - \Delta_{\underline{h}}(\underline{h}, \overline{w})\right] < 0. \end{aligned}$$

That is, the higher the probability of meeting $\overline{w}$, the more likely it is that $\underline{h}$ will divorce. Suppose $\pi_{2T+1}^{\overline{w}*}$ solves $\sum_{t=2T}^{2T+1} \left(U_{\underline{h}}^{MM} - U_{\underline{h}}^{D*}\right) = 0$.[10] For any $\pi_{2T+1}^{\overline{w}} < \pi_{2T+1}^{\overline{w}*}$, it must be true that

$$\sum_{t=2T}^{2T+1} \left(U_{\underline{h}}^{MM} - U_{\underline{h}}^{D*}\right) > 0$$

That is, $(\underline{h}, \underline{w})$ will stay married if $\pi_{2T+1}^{\overline{w}} < \pi_{2T+1}^{\overline{w}*}$. ■

Observe that when $\pi_{2T+1}^{\overline{w}*}$ is greater than one, $(\underline{h}, \underline{w})$ will stay married even if $\underline{h}$ were certain of being matched with a higher earner in period $2T + 1$ : divorce is too costly compared to the gains from marrying a 'better fit'. In this setting low-low matchings are always stable in period $2T$. Becker (1991) argues that the association of likes is optimal when traits are complements and the association of unlikes is optimal when they are substitutes. However, if $h$ and $w$ differ only in their outside market opportunities, it is shown here that mating of likes is not always optimal even when traits are complements. Low-low matchings are not as attractive as high-low matchings since a rich husband would bring more private good consumption to a poor girl. In addition, unlike high-high matching in

[10] Note that $\pi_{2T+1}^{\overline{w}*}$ can be greater than 1.

which divorce is always inefficient, divorce can be efficient for low-low matching: if both can remarry a rich partner after divorce, then both may prefer divorce.

### $(\overline{h}, \underline{w})$ or $(\underline{h}, \overline{w})$ Marriages

The marital decision-making of negatively assortatively matched couples are similar to low-low marriages. If they divorce, the high earners may be matched with a 'better fit' whereas this is impossible the for low earners.

**Proposition 20** For given $\lambda_i$, high-low matching is stable only if the probability of marrying a high ability spouse subsequent to divorce is low enough.

**Proof** The proof is trivial and similar to that in Proposition 19 since high earners are always better off when matched with another high earner. However, when the probability of meeting another high earner is low enough, divorce is not worthwhile. ■

As with low-low couples, it is possible that a high ability partner may choose to remain with a low ability spouse if the cost of divorce is too high. Alternatively, when high earners accept a low ability spouse – fully anticipating subsequent divorce – they see the temporary marriage as worthwhile that it allows them to benefit from the speedy accumulation of the public good. If there is no cost to divorce, we would expect more temporary matchings taking place since individuals always benefit from sharing household public goods.

### 2.5.3 Period $2T-1$ Decision: to Get Married or Not

We now consider the decision that individuals make at period $2T-1$. Since divorce happens in even periods, married people only make a labor allocation decision. As was pointed out in section 2.4, this decision is independent of $G_{t-1}$, and is therefore effectively the same in every period. Thus in this section, we will focus on the decision to marry. At the beginning of period $2T-1$, both divorced and single never married people are randomly offered a mate and must choose whether or not to marry the proposed partner. Those who choose to reject remain single until the next odd period.

It is clear that the anticipation of the future – and in particular, whether or not individuals remain married in period $2T$, and whether or not they remarry in period $2T+1$ – affects decision-making in period $2T-1$. Marriage will not happen if $U_i^{SS} > \max\left\{U_i^{MM}, U_i^{MD}\right\}$ for $i \in (i,j)$ or $U_i^{SS} > U_i^{MD}$ and $U_j^{MD} > U_j^{MM}$ for $i \neq j$. That is, marriage will not happen if being single is a dominant strategy for one party. Secondly, if one party prefers to marry then divorce, whereas the other prefers staying single rather than getting divorced, marriage will not happen either: it may not be worthwhile to get married when expecting divorce. However, if $U_i^{MD} > U_i^{SS}$, then both parties prefer a short-term 'starter' marriage to remaining single and waiting for their next chance at marriage. In contrast to the decision to marry in period $2T+1$, it is more complex to characterise the conditions under which marriage will occur in period $2T-1$. This is because individuals have to take account of the fact that his/her partner may choose to divorce, which is impossible in period $2T+1$.

**Proposition 21** If $\Delta_{\overline{h}}(\overline{h},\overline{w}) \geq 0$,that is, $\overline{h}$ will accept $\overline{w}$ in period $2T+1$, given $\lambda_h = 0.5$, he will marry her in period $2T-1$.

**Proof** $\overline{h}/\overline{w}$ cannot do better by waiting for another time. They have been offered the best mate they can have. Therefore $(\overline{h},\overline{w})$ leads to marriage in period $2T-1$. ■

Given $\lambda = 0.5$ a high earner is always in favor of marriage in period $2T-1$ when offered another high earner. They can enjoy more household public goods without sacrificing private good consumption. In addition, they expect that they will stay married until the game ends after period $2T+1$.

It is obvious, unlike Becker's argument, that even though both $(\overline{h},\overline{w})$ and $(\underline{h},\underline{w})$ are both positively assortatively matchings their decisions to marry can be very different. For $\overline{h}/\underline{h}$, $\overline{w}$ is always better than $\underline{w}$. Therefore $(\overline{h},\overline{w})$ leads to marriage while $(\underline{h},\underline{w})$ may not. It is possible when the expected extra gain from marrying a rich partner is very high in the future, $\underline{h}$ or $\underline{w}$ may choose to stay single when offered another low earner in the hope that they may meet rich people hereafter. For a low earner whether or not to accept an offer of marriage with a low earner depends on the comparison between the cost of divorce and the expected gain from a better match with a high earner.

**Proposition 22** Given $\lambda_h$, there exists a maximal probability of meeting high earners in period $2T+1$, $\pi^{\overline{w}*}_{2T+1}$, such that for any $\pi^{\overline{w}}_{2T+1} < \pi^{\overline{w}*}_{2T+1}$ in period $2T-1$ $\underline{h}$ will marry $\underline{w}$.

**Proof** In order to determine whether or not $\underline{h}$ will accept $\underline{w}$, we need to compare his utilities when being married to his reservation payoff. His payoff if staying single is:

$$\sum_{t=2T-1}^{2T+1} U^S_{\underline{h},t} = U^S_{\underline{h},2T-1} + \delta U^S_{\underline{h},2T} + \delta^2 E U_{\underline{h},2T+1}$$

Observe that whenever $U_i^{MD} \geq U_i^{SS}$, being married is dominant strategy. Therefore we consider only the situation when $\lambda_i$ is lower enough that $U_i^{MD} < U_i^{SS}$. In that case, $(\underline{h}, \underline{w})$ leads to marriage only if they stay married. Therefore we derive the net gain between staying married and single as follows

$$\sum_{t=2T-1}^{2T+1} \left(U_{\underline{h}}^{MMM} - U_{\underline{h}}^{SS*}\right) = (1+\delta)\,\Delta_{\underline{h}}(\underline{h}, \underline{w}) + \delta^2 \pi^{\overline{w}}_{2T+1} \left[\Delta_{\underline{h}}(\underline{h}, \underline{w}) - \max\{\Delta_{\underline{h}}(\underline{h}, \overline{w}), 0\}\right]$$

Observe if $\underline{h}$ is rejected by a high earner in period $2T+1$, the above necessary condition can be rewritten as

$$\sum_{t=2T-1}^{2T+1} \left(U_{\underline{h}}^{MMM} - U_{\underline{h}}^{SS*}\right) = (1+\delta)\,\Delta_{\underline{h}}(\underline{h}, \underline{w}) + \delta^2 \pi^{\overline{w}}_{2T+1} \left[\Delta_{\underline{h}}(\underline{h}, \underline{w})\right]$$

which is always positive. It implies that he always prefers to marry $\underline{w}$ in period $2T$. On the other hand, if $\underline{h}$ is not rejected by a high earner in period $2T+1$, that is, $(\underline{h}, \overline{w})$ leads to marriage in period $2T+1$, we observe that

$$\frac{\partial \left( \sum_{t=2T-1}^{2T+1} \left(U_{\underline{h}}^{MMM} - U_{\underline{h}}^{SS*}\right) \right)}{\partial \pi^{\overline{w}}_{2T+1}} = \delta^2 \left[\Delta_{\underline{h}}(\underline{h}, \underline{w}) - \Delta_{\underline{h}}(\underline{h}, \overline{w})\right] < 0.$$

Therefore exists a maximal $\pi^{\overline{w}*}_{2T+1}$ that solves $\sum_{t=2T-1}^{2T+1} \left(U_{\underline{h}}^{MMM} - U_{\underline{h}}^{SS*}\right) = 0$ and for any $\pi^{\overline{w}}_{2T+1} < \pi^{\overline{w}*}_{2T+1}$ in period $2T-1$ $\underline{h}$ will marry $\underline{w}$ and for any $\pi^{\overline{w}}_{2T+1} \geq \pi^{\overline{w}*}_{2T+1}$ he will reject $\underline{w}$ and stay single. ■

Low-low matchings are different from high-high matchings. It is not worthwhile for a high earner to remain single when offered another high earner; whereas it may be

worthwhile for low earners to resist marriages even if they know they will accept a low-low match in the long term. High earners always accept another higher earner, knowing that their marriage will last forever. When divorce is costly, low earners may reject other low earners, if they have a great chance to get a 'better fit' in a subsequent period.

**Proposition 23** Given $\lambda_h$ and if high-low matchings lead to marriage in period $2T+1$, there exists a maximal probability of meeting high earners in period $2T+1$ such that in period $2T-1$ $\overline{h}$ will marry $\underline{w}$.

**Proof** We know that if $\overline{h}'s$ payoff when married then divorced is higher than that when staying single, he always prefers to marry. Now we analyse only the situation where he prefers staying married once he decides to marry $\underline{w}$. Similar to $\underline{h}$, we derive that

$$\sum_{t=2T-1}^{2T+1}\left(U_{\overline{h}}^{MMM}-U_{\overline{h}}^{SS*}\right)=(1+\delta)\,\Delta_{\overline{h}}(\overline{h},\underline{w})+\delta^2\pi_{2T+1}^{\overline{w}}\left[\Delta_{\overline{h}}(\overline{h},\underline{w})-\Delta_{\overline{h}}(\overline{h},\overline{w})\right]$$

Thus $\dfrac{\partial\left(\sum_{t=2T-1}^{2T+1}\left(U_{\overline{h}}^{MMM}-U_{\overline{h}}^{SS*}\right)\right)}{\partial\pi_{2T+1}^{\overline{w}}}=\delta^2\left[\Delta_{\overline{h}}(\overline{h},\underline{w})-\Delta_{\overline{h}}(\overline{h},\overline{w})\right]<0$. Therefore there must exist a maximal $\pi_{2T+1}^{\overline{w}}$ such that in period $2T-1$ $\overline{h}$ would marry $\underline{w}$. ■

It is observed that when divorce is possible individuals decision-making in period $2T-1$ is very different from the last period where divorce is impossible. Even though a two-person household is more efficient than a single household in terms of public good production, the cost of divorce may offset such benefits. Individuals may prefer to stay single until they meet a 'perfect match'. The asset disposition rule upon divorce affects individual decision to marry.

## 2.6 Subgame Perfect Nash Equilibrium Analysis

In this section we analyse individual choices in every period. Recall that labor allocation decisions are independent of $t$. Consequently, we focus on individual decision-making about whether to marry in odd periods and whether to stay married in even periods. We investigate whether individuals will always accept someone they choose to accept in period $2T-1$ and whether they will always separate from someone they would choose to divorce in period $2T$. As we discussed before, individual decision-making is very different when facing the possibility of divorce and a 'better fit'. Consequently the decision making in period $2T+1$ is very different from any previous odd period. For case of exposition and with very little loss in generality, we assume that everyone will marry in last period.

**Proposition 24** Given $\lambda_i = 0.5$, in any odd period $(\overline{h}, \overline{w})$ always leads to marriage and high-high couples remain married. ■

The proof follows directly from the Propositions 21 and 18. High-high matching leads to marriage due to a positive marriage premium.

**Proposition 25** If $\frac{\pi^{\overline{w}}_{2T+1}}{\pi^{\overline{w}}_{2t+1}} \geq \frac{1-\delta^{2(T-t)+1}}{1-\delta}$ when $\delta \neq 1$, $\overline{h}$ will marry $\underline{w}$ in any previous odd period if $(\overline{h}, \underline{w})$ leads to marriage in period $2T-1$.

**Proof** In general there are two cases: temporary marriage is worthwhile or not. Recall that $\overline{h}$ will always accept $\underline{w}$ if $U^{MD}_{\overline{h}} \geq U^{SS}_{\overline{h}}$. If a temporary marriage is worthwhile in period $2T-1$, it will be worthwhile in any odd period. $(\overline{h}, \underline{w})$ always leads to marriage in any odd period. Now we consider the second case where a temporary marriage is not

worthwhile in period $2T-1$. In that case, $\overline{h}$ will accept $\underline{w}$ only if $(\overline{h},\underline{w})$ is stable, i.e., $U_{\overline{h}}^{MMM} \geq U_{\overline{h}}^{SS*} > U_{\overline{h}}^{MD*}$, which means $\sum_{t=2T-1}^{2T+1}\left(U^M - U^S\right) \geq 0$.

Similarly $\overline{h}$ will accept $\underline{w}$ in period $2T-3$ only if $(\overline{h},\underline{w})$ is stable since a temporary marriage is costly. Comparing the marriage premium across different periods, we have

$$\begin{aligned}&\sum_{t=2T-3}^{2T+1}\left(U^M - U^S\right) - \sum_{t=2T-1}^{2T+1}\left(U^M - U^S\right)\\ =\ &\left[\pi_{2T-1}^{\overline{w}}(\delta^2+\delta^3+\delta^4) - \pi_{2T+1}^{\overline{w}}\delta^2\right] * \left[\Delta_{\overline{h}}(\overline{h},\underline{w}) - \Delta_{\overline{h}}(\overline{h},\overline{w})\right].\end{aligned}$$

Observe that if $\dfrac{\pi_{2T+1}^{\overline{w}}}{\pi_{2T-1}^{\overline{w}}} \geq \dfrac{1-\delta^3}{1-\delta}$ when $\delta \neq 1$, $\sum_{t=2T-3}^{2T+1}\left(U^M - U^S\right) \geq 0$, i.e., $\overline{h}$ will accept $\underline{w}$ at period $2T-3$. In general if $\dfrac{\pi_{2T+1}^{\overline{w}}}{\pi_{2t+1}^{\overline{w}}} \geq \dfrac{1-\delta^{2(T-t)+1}}{1-\delta}$ we can conclude that $\overline{h}$ will marry $\underline{w}$ in any previous odd period. ■

**Lemma 1** If $\pi_{2t+1}^{\overline{w}} \geq \pi_{2T+1}^{\overline{w}}$ and divorce is costly, $\overline{h}$ may reject $\underline{w}$ in period $2t-j$ even though he accepts her in period $2T-1$.

**Proof** When divorce is costly, $\overline{h}$ will accept $\underline{w}$ only if $(\overline{h},\underline{w})$ is stable. However, in period $2T-3$

$$\begin{aligned}&\sum_{t=2T-3}^{2T+1}\left(U^M - U^S\right) - \sum_{t=2T-1}^{2T+1}\left(U^M - U^S\right)\\ =\ &\left[\pi_{2T-1}^{\overline{w}}(\delta^2+\delta^3+\delta^4) - \pi_{2T+1}^{\overline{w}}\delta^2\right] * \left[\Delta_{\overline{h}}(\overline{h},\underline{w}) - \Delta_{\overline{h}}(\overline{h},\overline{w})\right] < 0.\end{aligned}$$

that is

$$\sum_{t=2T-3}^{2T+1}\left(U^M - U^S\right) < \sum_{t=2T-1}^{2T+1}\left(U^M - U^S\right).$$

Observe that $\sum_{t=2T-1}^{2T+1}\left(U^M - U^S\right) > 0$ does not guarantee $\sum_{t=2T-3}^{2T+1}\left(U^M - U^S\right) > 0$ as well. A high earner may prefer to stay single if offered a low earner in earlier periods, even

though a lower ability partner may be acceptable subsequently, when the perceived likelihood of meeting a high earner is too low to make it worthwhile to continue postponing marriage. ■

Unlike Becker (1991), the dynamics of household formation and dissolution is highlighted here. We not only show that low-low matched households may be unstable but also high-low matched households may be stable when traits are complements. When divorce is costly, a high earner may choose to remain single if offered a low ability mate instead of forming an 'unstable' matching. However, when the probability of meeting another high earner is too low, a high earner may accept a low ability person and stay stable.

**Proposition 26** If $\frac{\pi^{\overline{w}}_{2T+1}}{\pi^{\overline{w}}_{2t+1}} \geq \frac{1-\delta^{2(T-t)+1}}{1-\delta}$ when $\delta \neq 1$, $\underline{h}$ will marry $\underline{w}$ in any earlier odd period if $(\underline{h}, \underline{w})$ and $(\underline{h}, \overline{w})$ lead to marriage in period $2T-1$.

**Proof** Whenever $U_i^D \geq U_i^S$ being married is always dominant. Otherwise low-low matchings lead to marriage only if they are stable. Therefore, in period $2T-1$ it must be true that $U_{\underline{h}}^{MMM} \geq U_{\underline{h}}^{SS*} > U_{\underline{h}}^{MD*}$. In period $2T-3$, the decision-making of low-low pair is exactly the same as in period $2T-1$: they get married only if they are stable. Comparing the payoff between getting married and staying single:

$$\sum_{t=2T-3}^{2T+1} \left(U^M - U^S\right)$$

$$= \sum_{t=2T-1}^{2T+1} \left(U^M - U^S\right) + \left[\pi^{\overline{w}}_{2T-1}(\delta^2+\delta^3+\delta^4) - \pi^{\overline{w}}_{2T+1}\delta^2\right] * \left[\Delta_{\underline{h}}(\underline{h}, \underline{w}) - \Delta_{\underline{h}}(\underline{h}, \overline{w})\right].$$

Observe that if $\frac{\pi^{\overline{w}}_{2T+1}}{\pi^{\overline{w}}_{2t+1}} \geq \frac{1-\delta^{2(T-t)+1}}{1-\delta}$ when $\delta \neq 1$, $\underline{h}$ will marry $\underline{w}$ in any previous odd period and their marriage lasts forever. ■

It is observed that low-low matching may not lead to marriage at the beginning. However, when the chance of meeting a high earner is decreasing with time it is not worthwhile for low earners to wait and once low-low matchings lead to marriage they are stable.

**Proposition 27** Suppose in period $2T$ $(\overline{h}, \underline{w})$ is dissolved. If the probability of meeting $\overline{w}$ is constant and for a given $\lambda$, $\overline{h}$ will separate from $\underline{w}$ in earlier even period as well.

**Proof** Based on the fact that in period $2T-1$, $(\overline{h}, \underline{w})$ chooses to divorce, it must be true that $U^{MD*} \geq \max\{U^{SS*}, U^{MMM}\}$. That is $\sum_{t=2T}^{2T+1} \left(U^M - U^D\right) < 0$ at period $2T$. Comparing the gain from divorce at period $2T-2$ to that at period $2T$, we have

$$\begin{aligned} & \sum_{t=2T-2}^{2T+1} \left(U^M - U^D\right) \qquad (2.35) \\ = \; & \left(1-\delta^2 \pi^{\overline{w}}_{2T-1}\right) * \sum_{t=2T}^{2T+1} \left(U^M - U^D\right) + \\ & \left[\delta \pi^{\overline{w}}_{2T-1}\left(1+\delta+\delta^2\right) - \pi^{\overline{w}}_{2T+1}\delta\right] * \left[\Delta_{\overline{h}}(\overline{h}, \underline{w}) - \Delta_{\overline{h}}(\overline{h}, \overline{w})\right]. \end{aligned}$$

Observe that when $\pi^{\overline{w}}_{2T-1} = \pi^{\overline{w}}_{2T+1}$, $\sum_{t=2T-2}^{2T+1} \left(U^M - U^D\right) < 0$ since $\sum_{t=2T}^{2T+1} \left(U^M - U^D\right) < 0$. $(\overline{h}, \underline{w})$ dissolves in period $2T-2$: high-low matchings will dissolve in any earlier odd period. ■

**Lemma 2** If $\frac{\pi^{\overline{w}}_{2T+1}}{\pi^{\overline{w}}_{2t+1}} \leq \frac{1-\delta^{2(T-t)+1}}{1-\delta}$ for $\delta \neq 1$, $\overline{h}$ will divorce $\underline{w}$ in earlier even period if $(\overline{h}, \underline{w})$ is dissolved in period $2T$.

**Proof** From the Equation 2.35 we notice that as long as $\delta \pi^{\overline{w}}_{2T-1}\left(1+\delta+\delta^2\right) - \pi^{\overline{w}}_{2T+1}\delta \geq 0$, $(\overline{h}, \underline{w})$ will dissolve in period $2T-2$. That is whenever $\frac{\pi^{\overline{w}}_{2T+1}}{\pi^{\overline{w}}_{2t+1}} \leq \frac{1-\delta^{2(T-t)+1}}{1-\delta}$ for $\delta \neq 1$, high-low matchings are unstable. ■

The stability of high-low matchings depends on the probability of meeting a 'better fit'. Obviously, if the probability of meeting a high ability spouse is constant, divorce is desirable in any odd period if it is in period $2T$. However, if the probability of meeting a high ability spouse is increasing with time, a temporary marriage may last for a while until the probability is greater enough. So the fact that individuals accept someone does not mean they would accept the same partner in a later period. Likewise, if individuals divorce at time $t$, this does not mean they always divorce a similar partner in a later period.

**Remark 1** If at period $2T$, $\underline{w}$ does not want to divorce from $\overline{h}$, neither does she in any earlier period.

Unlike the other matchings, whether or not $(\underline{h}, \underline{w})$ will divorce in any earlier even period, given that they separate in period $2T$, is very complicated and depends very much on whether $(\underline{h}, \overline{w})$ or $(\overline{h}, \underline{w})$ leads to marriage or not after $(\underline{h}, \underline{w})$ dissolves. We can show that in the case negative matching does not lead to marriage, the dissolution of $(\underline{h}, \underline{w})$ in period $2T$ does not guarantee they will do so in period $2T - 2$. This results is nonetheless astonishing since one of gains from divorce for lower earner is to marry a high earner. It is certain that if a high earner always accepts a lower earner, an increasing probability of meeting high earner will encourage low-low matchings to dissolve as well as the high-low pairs.

**Proposition 28** A Nash equilibrium exists.

**Proof** This follows trivially from the fact that (S,S), where both partners choose to remain single, is always a Nash equilibrium: since the payoffs to both spouses are identical when only one spouse chooses to remain single and when both spouses choose to remain single, neither partner can improve their payoff by deviating from (S,S), and so (S,S) is a trivial equilibrium. Note that (S,S) is always an equilibrium is very much driven by the assumption that marriage needs mutual consent. ■

It is worthwhile stressing that individuals will marry if they can get more from the marriage without paying any cost of divorce. In that case (S,S) would disappear as a Nash equilibrium. On the contrary, if individuals prefer staying married to remaining single and then to getting married then divorce, they would not choose to marry if there is a risk of divorce. From above, we observe that when the asset division rule $\lambda_i$ upon divorce makes divorce too costly, individuals may prefer to wait until they meet a 'better' fit. Otherwise, they may accept the imperfect matching as a 'temporary' one. However, when the chance of meeting a 'better' fit is getting lower and lower, an 'imperfect' matching may turn out to be stable. In general an increasing probability of meeting high-earner would result in more likely 'temporary' household to occur. Individuals certainly want to benefit from the economy scales of household public goods production as long as the cost of divorce is moderate. A costly divorce has double-side effect: it not only promotes stable marriage but also discourage the formation of 'temporary' household, which could turn out to be stable with time. Therefore, it cannot be determined whether or not increasing the cost of divorce is desirable.

## 2.7 An Example

In this section an example is presented in order to understand the behaviour of the model better. We assume that $T = 5$. A quasi-linear utility function is assumed for each individual:

$$\begin{aligned} U_{it}^{s} &= x_{it} + \ln G_t + \ln G_{t-1}\ i \in h, w \\ \text{where } s &= \text{state, } s \in \{\text{single, marry, divorce}\} \\ t &= \text{time , } t \in \{1,2,3,4,5\}\,. \end{aligned}$$

We assume that $\delta$ equals one and we consider a symmetric production function.

$$\begin{aligned} G_t &= k_{ht}^{0.5} + k_{wt}^{0.5} \text{ for two-person household;} \\ &= k_{ht}^{0.5} \text{ or } k_{wt}^{0.5} \text{ for one-person household.} \end{aligned}$$

### 2.7.1 Labor Allocation within One-Person and Two-Person Household

#### One-Person Household

It is easy to deduce in optimum for $\overline{h}$ (it is straightforward for $\overline{w}$) , in equilibrium

$$k_{\overline{h}t} = \frac{1}{2\overline{h}}; x_{\overline{h}t} = \overline{h}L - \frac{1}{2}; \text{ and } \overline{G}^{S*} = \left(\frac{1}{2\overline{h}}\right)^{0.5}.$$

For $\underline{h}$ in equilibrium

$$\begin{aligned} k_{\underline{h}t} &= \frac{1}{2\underline{h}}; x_{\underline{h}t} = \underline{h}L - \frac{1}{2}; \text{ and } \underline{G}^{S*} = \left(\frac{1}{2\underline{h}}\right)^{0.5} = \gamma^{0.5}\overline{G}^{S*} \\ \text{where } \gamma &= \frac{\overline{h}}{\underline{w}} = \frac{\overline{w}}{\underline{h}}. \end{aligned}$$

### Two-Person Household

Suppose the sharing rule of private good consumption is half-half, $\theta_i = 0.5$. At the optimum within positive assortative matchings:

$$k_{ht} = k_{wt} = \frac{1}{2\overline{h}}; G_t = 2\overline{G}^{S*} \text{ for } \left(\overline{h}, \overline{w}\right); \text{ or } 2\underline{G}^{S*} \text{ for } \left(\underline{h}, \underline{w}\right); \text{ and } x_{it}^* = hL - \frac{1}{2}.$$

Similarly, within negative assortative matchings $\left(\overline{h}, \underline{w}\right)$, at the optimum

$$\begin{aligned} k_{ht} &= \frac{1}{\gamma+1} * \frac{1}{\overline{h}}; \; k_{wt} = \frac{\gamma}{\gamma+1} * \frac{1}{\underline{w}} \\ x_{it} &= \frac{L}{2}\left(\overline{h} + \underline{w}\right) - \frac{1}{2}; \text{and } G_t = \overline{G}^{S*}\left[2(\gamma+1)\right]^{0.5} = G^{NA}. \end{aligned}$$

## 2.7.2 Marital Decisions

### Period 5 Decision: Marry or Not

In the last period, every single person decides whether to marry or not. We have shown before that positively assortative matching leads to marriage in the last period. Now we examine only whether or not a negative assortative matching leads to marriage. Whether or not $\overline{h}$ accepts $\underline{w}$ at period 5 depends on his payoffs. Furthermore the difference of his payoff being married and being single is

$$U_{\overline{h}}^M - U_{\overline{h}}^S = \frac{1}{2}(\underline{w} - \overline{h})L + \frac{1}{2}\ln 2 + \frac{1}{2}\ln(\gamma+1) + \ln(1+\gamma^{0.5}).$$

Observe that when the relative earning power, $\gamma = 1.21$ and $\underline{w}L = 10$, then $U_{\overline{h}}^M - U_{\overline{h}}^S \simeq 0.44 > 0$. Negative assortative matchings lead to marriage at period 5 too.

## Period 4 Decision: Stay Married or Not

From Proposition 18, we have shown that $(\overline{h}, \overline{w})$will stay married given $\lambda_i = 0.5$. A high earner cannot have a 'better fit' in next period and therefore a high-high matching is stable. A low-low matching is different from a high-high since a low earner can be rematched with a high earner, a 'better' fit, in period 5. Therefore to determine if a $(\underline{h}, \underline{w})$ is stable, we have to compare the loss from of divorce to the expected gain from marrying a rich partner. Observe that if, say, $\underline{h}$ stays married, his payoff is

$$\sum_{t=4}^{5} U_{\underline{h}}^{M} = 2\left[\underline{h}L - \frac{1}{2} + \ln 2\underline{G}^{S*} + \ln 2\underline{G}^{S*}\right]$$

while if he divorces, his payoff is:

$$\begin{aligned}\sum_{t=4}^{5} U_{\underline{h}}^{D} &= \underline{h}L - \frac{1}{2} + \ln \underline{G}^{S*} + \ln\left(\lambda_h * 2\underline{G}^{S*}\right) \\ &+\pi_5^{\overline{w}}\left[\frac{1}{2}(\underline{h}+\overline{w})L - \frac{1}{2} + \ln G^{NA} + \ln(\overline{G}^{S*} + \underline{G}^{S*})\right] \\ &+\pi_5^{\underline{w}}\left[\underline{h}L - \frac{1}{2} + \ln 2\underline{G}^{S*} + \ln 2\underline{G}^{S*}\right]\end{aligned}$$

Comparing his payoffs we can derive that

$$\sum_{t=4}^{5}\left(U_{\underline{h}}^{D} - U_{\underline{h}}^{M}\right) = -2\ln 2 + 0.96\pi_5^{\overline{w}} < 0$$

Therefore staying married is a dominant strategy for $\underline{h}(\underline{w})$. Even he knows he could be rematched with a high-earner with certainty, he still chooses to stay married with $\underline{w}$. The extra gain from marrying a rich partner is not great enough to compensate the cost of divorce.

Now we look at whether or not negative assortative matchings divorce in period four. Similar to low-low matchings, a high earner can be rematched with another high earner

in period five if high-low matchings are dissolved in period four. Whether or not a high-low matching is stable depends on the probability of meeting another high and the cost of dissolving the temporary marriage. We observe that for $\overline{h}$, his payoff if staying married is

$$\sum_{t=4}^{5} U_{\overline{h}}^{M} = 2\left[\frac{1}{2}(\underline{w}+\overline{h})L - \frac{1}{2} + \ln G^{NA} + \ln G^{NA}\right]$$

while his payoff if getting divorced is

$$\begin{aligned}\sum_{t=4}^{5} U_{\overline{h}}^{D} &= \overline{h}L - \frac{1}{2} + \ln \overline{G}^{S*} + \ln\left(\lambda_h * G^{NA}\right) \\ &+\pi_5^{\overline{w}}\left[\overline{h}L - \frac{1}{2} + \ln 2\overline{G}^{S*} + \ln 2\overline{G}^{S*}\right] \\ &+\pi_5^{\underline{w}}\left[\frac{1}{2}(\underline{w}+\overline{h})L - \frac{1}{2} + \ln G^{NA} + \ln(\overline{G}^{S*} + \underline{G}^{S*})\right]\end{aligned}$$

It is observed that

$$\sum_{t=4}^{5}\left(U_{\overline{h}}^{D} - U_{\overline{h}}^{M}\right) = -0.39 + 0.95\pi_5^{\overline{w}}$$

When $\pi_5^{\overline{w}} \geq 0.41$, $\overline{h}$'s payoff upon divorce is higher than that of remaining married with $\underline{w}$.[11] Their marriage will be dissolved. Otherwise, he stays married with $\underline{w}$. That is, whenever the probability of meeting another high earner in period five is less than 0.41, $(\overline{h}, \underline{w})$ stays stable.

Above results show that positive assortative matchings are stable at period four while negative assortative matching are not. When the likelihood of meeting $\overline{w}$ for $\overline{h}$ is great enough, he will separate from $\underline{w}$. On the other hand, if the likelihood of meeting $\overline{w}$ is too low, he would rather than stay married with $\underline{w}$ even he knows that she is not the 'perfect' one. The expected gain from a 'better' match exceeds the loss from dissolving the present one. A temporary marriage lasts until the end.

[11] It is checked that $\underline{w}$ would like to stay married.

## Period 3 Decision: Get Married or Not

Recall that high-high matchings always lead to marriage while high-low or low-low may not. The reason for a high-low or low-low matching may not lead to marriage is the fact that individuals may prefer to wait for a 'better fit' rather than to form a 'temporary' marriage. Thus, we examine only whether or not a low-low matching and a high-low matching lead to marriage in period three. First we observe that $\underline{h}'s$ payoff when married then divorced with $\underline{w}$ is always greater than being single:

$$\sum_{t=3}^{5}\left(U^{MD}-U^{SS}\right)=2\ln 2>0.$$

Therefore being married is dominant strategy for him and so does she. A low-low matching leads to marriage in period three. Similarly we investigate the decision-making of $\left(\overline{h},\underline{w}\right)$. It is easy to verify that for $\overline{h}$

$$\begin{aligned}\sum_{t=3}^{5}\left(U^{MD}-U^{SS}\right) &= \frac{1}{2}(\underline{w}-\overline{h})L+\ln\lambda_h+\ln\left[2\left(\gamma+1\right)\left(1+\gamma^{0.5}\right)\right]\\ &= 0.48>0.\end{aligned}$$

and for $\underline{w}$

$$\sum_{t=3}^{5}\left(U^{MD}-U^{SS}\right)=\frac{1}{2}(\overline{h}-\underline{w})L+\ln\lambda_w+\ln\left[\frac{2\left(\gamma+1\right)\left(1+\gamma^{0.5}\right)}{\gamma^{1.5}}\right]>0.$$

Both $\overline{h}$ and $\underline{w}$ would like to marry and therefore a high-low matching leads to marriage too. So at the beginning of period three, single people will get married with whomever nature offers to them. Being married is dominant strategy for everyone in period three.

## Period 2 Decision: Stay Married or Not

The decision-making of $(\overline{h}, \overline{w})$ in period two is exactly same as period four and therefore they will stay married. The decision-makings of $(\underline{h}, \underline{w})$ and $(\overline{h}, \underline{w})$ is similar to their decisions at period four except now they are facing different probability of meeting high earners and therefore the expected gain from marring a high earner is different. First we examine whether or not low-low matchings are stable. Without loss of generality, we look at $\underline{h}'s$ decisions. It is easy to verify that in the case that a low-low matching is stable in period two whenever a high-low matching is unstable in period four. On the other hand, if a high-low matching is stable in period four, the difference of $\underline{h}$'s payoff between when staying married with $\underline{w}$ and divorcing then remarrying is:

$$\sum_{t=2}^{5} \left( U_{\underline{h}}^{M} - U_{\underline{h}}^{D} \right) = 2 \ln 2 - 2.88 \pi_3^{\overline{w}}.$$

Observe that if and only if $\pi_3^{\overline{w}} \geq 0.482$, $U^M < U^D$, that is, $(\underline{h}, \underline{w})$ will dissolve in period two. Otherwise, they will stay married. It is worthwhile to point out again that low-low assortative matchings, unlike high-high matchings, may be unstable. A poor person wants to marry a millionaire for luxury goods and their marriage may last forever.

For $(\overline{h}, \underline{w})$ matching, $\overline{h}$ will choose to divorce if and only if the expected payoff from divorce exceeds the payoff from staying married with $\underline{w}$. If $\overline{h}$ divorces in period two, he faces a probability $\pi_3^{\overline{w}}$ of meeting $\overline{w}$, a probability $\pi_3^{\underline{w}}$ of meeting $\underline{w}$ at period three. If remaining married with $\underline{w}$, there are two possibilities for $\overline{h}$: getting divorced in period four if $\pi_5^{\overline{w}} \geq 0.41$; or staying married with $\underline{w}$ until the last period. Comparing his payoffs under both cases, we derive that

- In the case where he gets divorced in period four, i.e. if $\pi_5^{\overline{w}} \geq 0.41$

$$\sum_{t=2}^{5} \left(U_{\overline{h}}^{M} - U_{\overline{h}}^{D}\right) = 0.39 - \pi_3^{\overline{w}} \left(2.29 + 0.95\pi_5^{\underline{w}}\right).$$

- In the case where he stays married in period four, i.e., $\pi_5^{\overline{w}} < 0.41$

$$\sum_{t=2}^{5} \left(U_{\overline{h}}^{M} - U_{\overline{h}}^{D}\right) = 0.39 - 2.85\pi_3^{\overline{w}}.$$

In both cases, there exist possibilities that $(\overline{h}, \underline{w})$ would be dissolved.[12]

It is observed that when $\pi_3^{\overline{w}} \geq 0.137$, $(\overline{h}, \underline{w})$ would be dissolved no matter if they will stay married or not in period five. The likelihood of meeting a 'like' is great enough to entice a high earner from negative assortative matching. It once again shows that only high-high matchings are stable while both high-low and low-low matchings may be unstable. However, when the chance of meeting a high earner is too low, both high-low and low-low matchings are stable.

## Period 1 Decision: Get Married or Not

It is observed that $U_i^{MD} \geq U_i^{SS}$ for $i = \{h, w\}$. Thus being married is dominant strategy for everyone. Consequently, at the beginning of the game, everyone would like to get married even if they may be matched with an imperfect partner. They accept an imperfect matching as a 'temporary' one in the hope of next time they may get someone else. However, with time a 'temporary' marriage could be stable if the chance of getting someone better is decreasing. Individuals benefit from the economy scales of two-member house-

[12] $\underline{w}$'s decision has also been checked and it is found that she would prefer to stay married.

hold. If the chance of meeting someone 'better' is too low, they would remain married with the present spouse. After all, living with somebody is better than living alone.

## 2.8 Conclusions

All in above shows that individual decision-makings are affected by the possibilities of divorce and remarriage. It is shown that marrying a rich person is welfare improving in given period. Therefore low-low matchings are different from high-high matchings. High-high matched households are most likely to be stable and therefore getting married then staying married is the dominant strategy for a high earner when offered another high earner. However, whether or not a high earner accepts a low earner depends on the comparison of his/her expected payoffs between from getting married and from staying single for a while in the hope of a 'better fit' being offered later. A costly divorce will discourage a high earner from accepting the proposed low ability person. A 'temporary' marriage is just not worthwhile. Similarly, a low earner may reject another low earner with expecting next time (s)he can marry a high earner. In the contrast, when divorce is not costly, individuals may choose to form a 'temporary' household and wait for a 'better fit' in the marriage. A 'temporary' marriage may turn out to be stable if the chance of getting a 'better fit' is too low.

Our results are different from what Becker (1991) found – the mating of likes is optimal when traits are complements while the mating of unlikes is optimal when traits are substitutes. We show that the mating of likes may be unstable and the mating of unlikes may be stable even when traits are complements. The low-low matchings and high-low

matchings, unlike the high-high ones, are typically opportunistic. Everyone wants to marry a rich person as long as a rich person accepts a poor spouse. We also examine how the policy governing divorce affects individual decision to marry and divorce. The effects of policy variable, asset division rules upon divorce are double-sided: it not only promotes stable marriage but also discourages a 'temporary' marriage.

The next natural application of the framework developed to date is to introduce an endogenous fertility decision. Children are a non-divisible public good within a marriage unlike the quasi-durable public good considered in the existing framework. Therefore divorce settlements must specify how each partner will continue to support the children after the marriage has dissolved. We anticipate to investigate how the existence of children affects the pattern of asset accumulation within households in our future work.

# Chapter 3
# An Empirical Investigation of the Impact of Public Goods and Public Policies on Household Dynamics

## 3.1 Introduction

Why do couples continue to marry knowing that about one in three marriages end in divorce?[13] Several authors have tried to answer this question by focusing principally on (mis)matching models and incomplete information (e.g., Becker 1973, 1974; Weiss and Willis 1997). However, the fact that an increasing proportion of couples are living together prior to 'tying the knot', leaves one wondering how likely matching and incomplete information are as explanations to the marriage-divorce quandary. Essays one and two of this thesis develop models that show how the acquisition of public goods provides one answer to this puzzling question: individuals marry in order to share in the benefits flowing from the joint production of household goods. It can then be rational to divorce when the benefits from one's post-marital share of these public goods (from essay one) or the possibility of additional benefits flowing from a different partnership (from essay two) exceed the current household division of private and public goods. An imperfect matching could also become a stable one because of the loss from one's post-marital share of these public goods.

[13] See Statistics Canada (2000).

When we think of public goods within a marriage, three types of goods come to mind: physical assets like the family home (cottages, cars and boats), children, and companionship (love, affection). The public good nature of physical assets is straightforward. The literature looking at the role of children within a household considers them as being either a public good that provides consumption services to their parents during their childhood (e.g., Becker 1974; Becker *et al.* 1977; Weiss and Willis 1985; Zelder 1993), or as an investment good that will yield a return once they attain adulthood (or are able to work) (Rosati 1996). While this latter definition more aptly describes children in much of the developing world, the former seems to describe the vision of children in the more affluent world. Several authors have examined empirically the role played by children in the propensity to divorce.[14] For instance, the pioneering study by Becker *et al.* (1977) shows clearly that the number of children, especially younger children, reduces the probability of divorce. Waite and Lillard (1991) argue that children constitute the prime example of "marital-specific capital", a resource worth substantially more inside a marriage than outside it. They examine the effect of children on marital stability by using the US Panel Survey of Income Dynamics (PSID), and show that young children decrease the chance of marital disruption – an effect that is strongest for the first birth. However, their results also indicate that over the long run, marriages with many children are only slightly more likely to survive than marriages with few. Furthermore, they show that older children and children born before marriage significantly increase the chances of marital disruption.

[14] Table A1 in the appendix provides a review of the empirical papers analyzing primarily divorce.

Further research looking at how different divorce law (unilateral vs. mutual) and the post-marital financial situation affect divorce, was undertaken by Peters (1986,1993). Using the 1979 Current Population Survey, Peters (1986) argues that the unilateral divorce rule is insignificant while it does increase the labour participation of married women. Peters (1993) measures the opportunity cost of divorce as the difference in the present values of the future income streams that a married woman might expect if she were to stay married rather than become divorced. Results using data from the US National Longitudinal Study's Young Women's cohort indicate that women take into consideration the short-run financial consequences before making decisions about divorce.

Of particular interest to our study is Zelder (1989, 1993) who focuses specifically on the role of children as public goods and how they interact with public policies governing divorce. Using the US PSID data set, he shows that important public goods, like children, have an impact on divorce that varies according to divorce regime. One implication of his work is that no-fault regimes in which divorce can be sought unilaterally may be less desirable than mutual-consent regimes, at least for couples with children or other important marital public goods. Unlike Peters (1986), Zelder showed that the unilateral divorce law is significantly increasing the likelihood of divorce through the existence of children within households. In addition to Zelder (1989, 1993), others have recognized how certain public policies affect the decisions to divorce. For instance, Nixon (1997) examines the effect of government child support enforcement (CSE) on marital dissolution.

In contrast to the rich empirical literature on divorce, relatively few papers examine the factors that prompt individuals to marry. This is not so astonishing, since popu-

lar culture suggests that individuals enter into these relationships because of a mysterious chemical effect. In a departure with the literature, Nakosteen and Zimmer (1997) analyze the probability of divorce and marriage while examining whether married men earn more income than their non-married counterparts because they are economically attractive candidates for marriage in the first place (the economic-selection hypothesis). They use the three waves of the Panel Survey of Income Dynamics (PSID) and model individual marital-status transitions as functions of variables that capture men's earning prospects. The marriage analysis includes age, educational credentials, race, and variables for parent's educational attainments. The divorce analysis includes the number of children at three age groups rather than parent's educational attainments. Their results show that single men with favourable earning prospects are more likely to marry. Married men with favourable expected earnings are less prone to divorce.

The goal of this essay is to conduct an empirical investigation into the determinants of marriage and divorce, with specific emphasis on how public goods and public policies affect these two decisions. Decisions to marry and decisions to divorce are not only about emotional factors but also, perhaps more importantly, about socio-economic considerations. One insight revealed by the theoretical models of essays one and two is that the division of public goods post-marriage may profoundly influence the decision not only to divorce but also to marry. Would a millionaire marry a poor person if his or her assets were split equally upon divorce? Marriage contracts may also reflect the effects of asset division rules upon divorce. This paper focuses on one particular public policy of this nature, namely the introduction of the Child-Support guidelines (or Guidelines) in Canada in 1997.

Child support payments are an important factor influencing the amount of wealth each partner takes from the marriage.[15] On March 6, 1996 the federal government announced its plans to introduce sweeping changes to the manner in which child-support payments were computed, with the introduction of its Child Support Guidelines in 1997.[16] Compared to the old regime, custodial parents are receiving more child support payments in most cases. Therefore, the cost of divorce for non-custodial parents increased with the new regime, while the cost of divorce for custodial parents decreased.

One contribution of this essay is that it examines how the new Guidelines affect the decisions to marry and the divorce in Canada. It also contributes to the empirical literature on the determinants of divorce by being the first to use a Canadian micro-level panel data set to examine these influences. It also contributes to the much smaller literature on the determinants of marriage, being one of the first papers to empirically investigate how public goods and post-marital policies may affect the decision to marry as well.

## 3.2 The Data

The main data used in this analysis come from the confidential Survey of Labour Income Dynamics (SLID) developed and maintained by Statistics Canada.[17] The SLID tracks

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[15] At the current time, child support payments are based on the non-custodial parent's income and the number of children in the household. For a criticism of this approach see Barham and Devlin (2003).

[16] In addition to introducing the child-support guidelines, the federal government also changed the tax treatment of support payments-which effectively increased the amount of money staying in the pocket of the custodial parent, plus made changes to the enforcement of child-support payments (see, Department of Justice, 1998)

[17] I am extremely grateful to the Statistics Canada which provided the resources necessary to access and analyze the SLID data. Details regarding SLID can be obtained from Statistics Canada (SLID Microdata User's Guide, 1994).

cohorts of individuals over six year waves which permits, among other things, a detailed analysis of the evolution of individual households over this period. It provides a rich array of information on an individual basis from 1993 to 1998 inclusive:[18] the SLID also allows us to identify individuals who decided to marry during the period of the sample and those who decided to divorce. Thus, rather than relying on the divorce rate based on the stock of divorced individuals at any point in time, the SLID data set allows us to determine the flow of individuals into marriage and into divorce. By tracking cohorts of individuals over time, and by providing detailed information on their personal and household characteristics, labour market characteristics, as well as a host of other variables, we are able to examine how several important variables influence the decisions to marry and divorce. The SLID also has the advantage of spanning a period before and after the introduction of the Child-Support Guidelines in 1997, enabling us to look at the impact on household formation and dissolution of this significant policy change.

While the SLID data set has many advantages for this research program, it is not perfect: for our purpose, it has two main weaknesses. First, it does not contain detailed information on assets and their value. Ideally, we would like to have detailed information on the types of assets accumulated by households and their value; unfortunately the SLID data set is unable to provide this information at this point in time.[19] However, the SLID does report at least two pieces of information that can be used to proxy the magnitude

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[18] Two 'panels' of the SLID are currently available– the first stretches from 1993 to 1998 and the second from 1996 to 2000.

[19] Statistics Canada has just undertaken a survey of asset accumulation that will ultimately result in much richer asset information in the SLID data set.

of the collective good: whether or not the family 'owns' its place of residence,[20] and the amount of income received through investments for the economic family. We can use these variables as indicators of asset accumulation during marriage. The second main weakness of the SLID is that only six years of individual-based information is available, and only two (or, arguably three) of these years are affected by the policy change of interest to this paper. We thus do not have a long time frame with which to track the impact of the new guidelines.

## 3.3 Econometric Framework: Estimating the Decisions to Marry and Divorce

The goal of this analysis is to examine how several factors influence an individual's decision to marry and/or divorce. Because we are particularly interested in how public goods and the new child-support guidelines affect marriage and divorce decisions, the time dimension present in the SLID data set is extremely important. Two features pertinent to our empirical problem require particular attention: first is the panel nature of the SLID data set, and especially whether we can find a model that will permit us to exploit the important time dimension of the data; and second is the dichotomous nature of the dependent variable. The fact that the decision to divorce necessarily follows the decision to marry suggests that a nested model may be an appropriate econometric approach to the problem. Indeed, the nested logit model matches very well the theoretical treatment developed in chapter one. One difficulty is that the model of chapter one, which is necessarily a highly stylised version

[20] Unfortunately, the SLID does not tell us anything about the value of the equity in the home.

of the real world, has individuals essentially choosing to marry knowing that they will divorce in the next period. It is as if all the decisions are taken at the same time. However, in reality we know that all the decisions are not taken at the same time: individuals can be married for a period of time and then divorced. We want our analysis to be able to capture both of these decisions. Ultimately, therefore, the nested logit procedure was considered to be unsuitable for the problem at hand. The same criticism can be levied against the bivariate probit model – which, in principle, can handle nested decisions, but, again, focuses on one final outcome. Finally, it was decided to separate the analysis of the two decisions – whether to marry and whether to divorce – in order to examine the factors underlying each decision without imposing undue constraints on the behaviour of individuals. Two paramount criteria governed the choice of econometric model: first, it had to be able to handle the panel nature of the data set enabling us to exploit the time dimension present in the SLID, and second, it had to be able to deal with the situation where individuals were making a discrete binary choice.

One class of models which have some appeal when estimating the probability of marrying or divorcing is duration models. To the extent that one expects the probability of, say, marrying to be dependent upon how long one has been single; or, perhaps more importantly, the probability of divorcing depending upon how long one has been married, then a duration (or hazard) model which calculates the conditional probability of the event taken place may be appropriate. There are basically two reasons why we have chosen not to employ this type of model: the first, and most important, is because of the lack of retrospective data; the second is due to the dearth of observations of a temporal nature. On the

first point, an important feature of duration models is their reliance on retrospective information to calculate a conditional probability: for instance, the probability of contracting breast cancer (the hazard) given your profile on a host of factors; the probability that you will continue to be unemployed, given your past and present (un)employment history. For the problem at hand, we are trying to determine the probability of marrying (or divorcing) given one's current and past situation – but the "past" begins in 1993. Aside from age, we do not have retrospective information on important factors underlying the decisions to marry (or divorce) from the beginning of singlehood (or marriage): for instance, we do not have information on income, education, or place of residence, prior to 1993. The SLID data set thus provides an inadequate control for the impact of time on these important determinants, and hence for their impact on the probability of changing marital status. This can lead to biased estimates of the effects on the hazard of time-dependent covariates.[21] The second less important drawback to using a duration-model framework for this particular problem stems from the fact that we only have six annual observations: changes which occur within the year will not be taken into account.

Of the menu of possible econometric procedures available to tackle the problem at hand, the panel logistic (logit) or panel probit models seem to best accommodate the problem at hand. In contrast to the duration model, the panel logit/probit model does not suffer from the censoring problem, however it does require that we control for duration effects. In other words, we have to control for the fact that the length of time in the state of being single (married) will affect the probability of marriage (divorce): age and age at first mar-

[21] See, for instance, the discussion in Allison (1984, 1995).

riage are instruments for duration in our panel models. A time trend is also included to pick up any omitted time-dependent influences in the model.

When dealing with a panel data set, one has to be concerned about two different across-unit effects (e.g., Greene, 2000): fixed effects and random effects. In the fixed effects model, differences across units, in our case across individuals, may be captured by differences in the constant term in the model. By contrast, the random effects approach views individual-specific constant terms as being randomly distributed over the cross-sectional units (Greene, 2000, p.567). For the basic regression model:

$$y_{it} = \alpha_i + \beta' x_{it} + \varepsilon_{it} \tag{3.36}$$

the fixed-effects approach posits $\alpha_i$ as group-specific constant terms, whereas the random-effects approach posits $\alpha_i$ as group-specific disturbance terms (Greene, 2000, p.560). However, applying panel techniques becomes extremely complicated when dealing with dichotomous dependent variables: estimating a panel probit model with fixed effects is not usually tractable because of the large number of constant terms this entails (e.g., Greene, 2000, p.837).[22] The logit model, by contrast, does allow for a fixed-effects treatment.[23] More formally, the fixed-effects logit model may be expressed as (e.g., Greene, 2000, p.840):

$$\begin{aligned} \text{prob}\left[y_{it}\right] &= \exp(d_{it})/[1+\exp(d_{it})] \\ d_{it} &= \alpha_i + \beta' x_{it} \end{aligned} \tag{3.37}$$

[22] However, in the most recent edition of Greene (2003, p.700), he indicates that a panel probit formulation with fixed effects can be estimated. Unfortunately, the STATA econometric package upon which our analysis relies, does not support a fixed effects panel probit model.

[23] Greene (2000) describes how the logistic distribution allows one to generate a consistent estimate of $\beta$ which is not a function of the fixed effect.

In this case, the constant terms are allowed to vary across individuals. Notice, however, that this specification implies that all individuals whose marital status remains unchanged over the period of study will be dropped from the sample.

By contrast, the random effects logistic model may be expressed as:

$$\begin{aligned} \text{prob}\,[y_{it}] &= \exp(d_{it})/[1+\exp(d_{it})] \\ d_{it} &= \beta' x_{it} + \mu_i, \end{aligned} \tag{3.38}$$

where $\mu_i$ is a group-specific random effect. This specification uses the information from all individuals in the sample, irrespective of whether their marital status changes. Thus, the analysis of this paper relies on estimates from the random-effect specification, rather than from the fixed-effects one.

Instead of using a panel logit model, we could have chosen to estimate the probability of marrying (or divorcing) by simply pooling the cross-sectional and time-series data together. We actually employed a likelihood ratio test to determine whether the panel estimator was statistically the same as the pooled estimator (the null hypothesis): this hypothesis was rejected.

Because we are estimating the decision to marry separately from the decision to divorce, and the determinants of these two decisions differ, we have to worry about what happens once the decision to marry (or divorce) is taken. For single individuals, for instance, once someone decides to marry (i.e., the dependent variable becomes "1") the problem facing the individual changes: it now becomes whether to remain married or to divorce; a decision different than the one initially faced. To address this problem, as soon as the

individual decides to marry (or to divorce), we exclude him or her from the sample in all periods following the one in which the decision is taken. Thus, we are working with an unbalanced panel in which the sample size shrinks over time commensurate with the number of individuals switching marital status.[24]

The choice of econometric models available to exploit the time dimension available in the data set given that the dependent variable is binary is very limited. As a way of seeing how robust our results are to model specification, we also estimate a logit model of the decision to marry or to divorce separately for each year of the data set. We can then estimate the predicted probability of marrying (divorcing) for a reference individual by year.

## 3.4 Descriptive Statistics

### 3.4.1 The Explanatory Variables

Guidance as to which variables to include in the empirical model was governed primarily by reference to the theoretical models of essay one and two of this thesis, plus reference to the empirical literature in the area. The variables used in the analysis plus their definitions are reported in table 1. From the theoretical model developed in essay one, we find that three main factors play an important role in the decisions to marry and divorce: the relative productivity of the partners, public goods, and the division of public goods upon divorce.

[24] For instance, for the single sample, we start off with 2686 males and end up with 2290, and with 2314 females and end up with 1850.

It is clear that the relative productivity of the partners affects their propensity to marry and to divorce. This is apparent in essay two, which focuses on what happens when unequally endowed individuals marry and are then given the opportunity to divorce and choose another partner. To this end, SLID provides information on individual earnings, as well as the relative earnings of partners within a marriage. But we do not know the earnings of the respondent and future spouse prior to their marriage, or post marriage in the event of divorce.

As far as public goods are concerned, we know if the individual owned his or her dwelling prior to marriage, and whether the individual lives in an owned dwelling during marriage. We do not know, unfortunately, the value of the equity in these dwellings. As additional indicators of the value of assets, we have information on capital gains and investment income. The SLID data set provides information on the number and age group of children. We are thus able to look at the impact of children on the decision to divorce. We are also able to examine, as suggested by the literature, whether there is a differential impact of young children versus older children on this decision.

The one main policy change occurring during the period of our study is the 1997 Child-Support Guidelines. Although these guidelines took effect in 1997, their much-anticipated announcement occurred in March 1996; given the time-lag typically experienced between separation and the signing of a separation agreement dealing with support, we expect that the guidelines influenced separations at least one year prior to their introduction. We examine the impact of this policy not only on the decision to divorce, but also on the decision to marry as well.

From the SLID we know the age of the individual and his or her age when first married (AFM). Rather than age itself, some researchers include age when first married (e.g., Zelder 1993) and its square (e.g., Becker *et al.* 1977) as determinants of divorce. We present several specifications which include AGE and its square as well as AFM and its square as well. Our analysis also includes several other variables as suggested by the literature in this area. For instance, Zelder (1993) finds that individuals who live in rural communities are less likely to divorce, *ceteris paribus*, relative to others. It is also possible that the ethnic and religious background of the individual will affect their propensity to marry and divorce (e.g., Johnson and Skinner 1986; Nakosteen and Zimmer 1997).[25] From SLID we can include information on whether or not the individual is an immigrant to Canada. The analysis also includes a measure of the educational level the individual measured in years of schooling. From existing literature, one expects that higher educated individuals are less likely to divorce, *ceteris paribus*. For instance, Nakosteen and Zimmer (1997) argue that higher-educated males are less likely to divorce because they have better prospects for higher future earnings than are less educated males.

Finally, our analysis includes dummy variables that vary according to the region of residence of the individual. Regional differences in marriage or divorce may arise from different community traditions. For instance, more people live in common-law marriages in Quebec than elsewhere (e.g., Wu 1998), thus defining marriage to include or not common law has an important impact on the estimated coefficient on the dummy variable representing residents of Quebec. In analysing a self-sufficiency project designed to get people off

[25] Unfortunately, the SLID does not provide individual's religion information.

of welfare, it was found that regional differences arose in the propensity of individuals involved in the project to marry. In particular, people in Nova Scotia were more likely to marry as a result of their project in comparison to those in British Columbia.[26] One possible explanation for such differences has to do with the culture of dependence upon government assistance developed over decades particularly in the poorer Atlantic Provinces.

The SLID micro-data set contains information on some 15,000 households each year, a figure that necessarily varies from year to year with people entering (e.g., marriage) and leaving (e.g., death) the cohort. From this data set, we extract two sub-sets of individuals with which to examine separately the decisions to marry and to divorce.

### 3.4.2 The Decision to Marry Sample

For the analysis of the decision to marry, we begin with all individuals who reported being single and never married in 1992 the year before the commencement of the first wave of the SLID. We drop from this sample all individuals over 54 years of age in 1992 following, for instance, Becker *et al.* 1977. A few individuals were also dropped whose reporting over time was clearly inconsistent.[27] After these adjustments, we were left with a sample of 5,000 individuals who were single, never married, in 1992 and who either remained single or became married (including common law) for the first time during the following six years. Among them 2,314 are females. We refer to this sample as the "single sample", as is described in figure 3.

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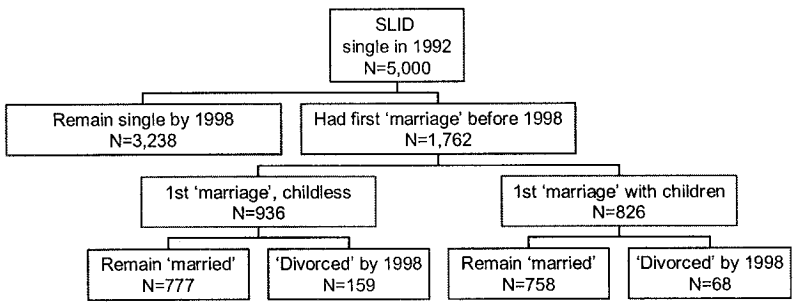
[26] See the paper by Gennetian, Morris and Harknett (2000).

[27] For instance, a few individuals reported being married in one year then single-never married in the following years. We also drop the handful of individuals who moved to the United States or who live in the Canadian Territories.

Single Sample



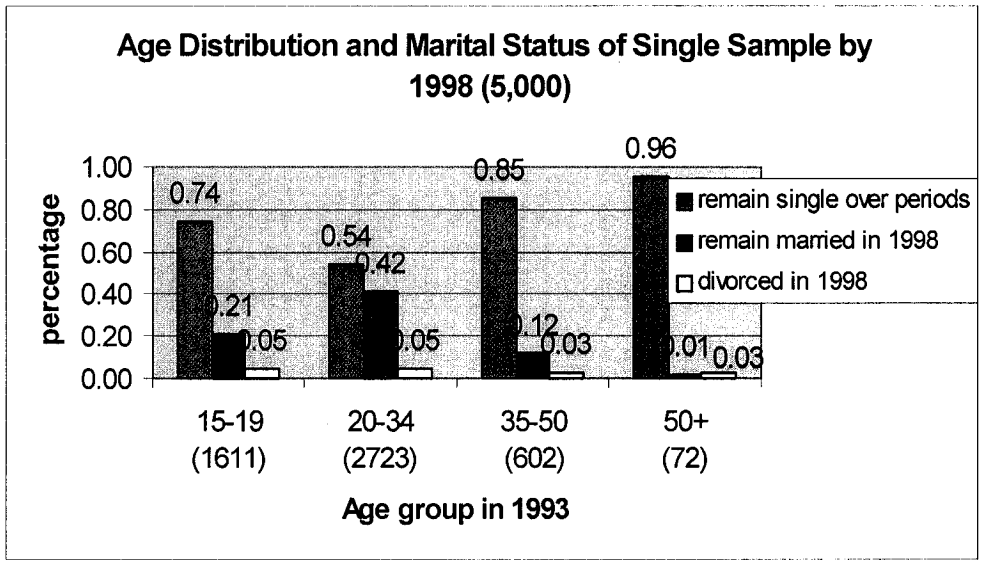

3.Sample of individuals who were single in 1992

Throughout this paper, the data are weighted by the sample weights provided by Statistics Canada to ensure that the sample reflects the Canadian population in 1992. Because the data set is both cross-sectional and longitudinal, we had two sets of weights: one that accounted for the importance of each observation in the cross-section, and the other that accounted for the importance of the observation over time. Since our analysis is particularly interested in exploiting the time dimension of the data set, especially with respect to tracking the impact of the 1997 child-support policy reform, we weight our data using the longitudinal weights. Following standard procedure, these weights are rescaled to equal the size of the sample under investigation (for instance, to be equal to 5,000 for the marriage sample) in order to avoid inflating the sample in a manner which could exaggerate the impact of the various factors under investigation.[28]

Table 2 presents some descriptive statistics of the single sample, disaggregated by gender, averaged over the six-year period of this study. As elaborated in the results section, it turns out that males and females do not always respond in the same way to the various determinants of marriage, hence we disaggregate the sample according to gender. The average age of the single individual (male or female) is 28 years, with an average of about 14 years of schooling. Males are economically better off in comparison to females, with higher earnings on average (18,407 dollars[29] versus 15,135 dollars), higher investment income (279 dollars versus 240 dollars) and more capital gains (103 dollars versus 54 dollars). About 60 per cent of males report living in owned dwellings in comparison to 53 per cent of females, and more males report owning their dwelling prior to marriage when com-

[28] See, for instance, the discussion in Greene (Limdep manual 1998, Ch.9) on this matter.

[29] 1998 Canadian dollars are used in the paper.




4.Age Distribution and Marital Status of Single Sample by 1998

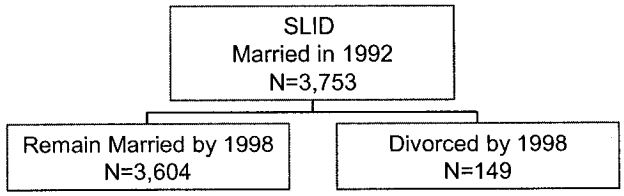
pared to females. Slightly more females live in urban centres as compared to men (89 per cent versus 86 per cent); the population is distributed in the expected manner throughout the Canadian regions. 13 per cent of the sample consists of immigrants.

Figure 4 presents the age distribution of the single sample in 1998. As one can see, most of the sample (2,723) are aged 20 to 34 (in 1998); of this group, 54 per cent remain single, 42 per cent get married and stay married, while only 5 per cent of individuals marry then divorce.

### 3.4.3 The Decision to Divorce Sample

To analyse the decision to divorce, we began with all individuals who were in their first marriage in 1992 and then matched them up with their partners, resulting in a sample of

Married Sample




5.Sample of Couples in their First Marriage in 1992.

3,753 "matched couples" in their first marriages in 1992.[30] Figure 5 displays the evolution of these couples over the period of study. Notice that only about 4 per cent of our couples were divorced by the end of 1998.[31]

Table 3 provides the descriptive statistics for the matched couples. The "wife" at 40 is on average two years younger than her "husband", whom she married, on average, at 23 years in comparison to his 25 years. The education level of both partners is very similar, around 13 years. 29 per cent of our married couples work in shifts that differ across the

[30] We had to drop a number of couples because of unreported or inconsistent information.

[31] Although the divorce rate in our sample appears to be small, we must remember that our sample consists of a mixture of recently married and long-term married couples. The statistic that about one-third of marriages end in divorce should really be stated as follows: about one-third of marriages will end in divorce within 30 years of marriage (e.g., Statistics Canada, 2000). For an excellent discussion about how divorce rates are calculated, with some cautionary notes regarding their interpretation and manipulation, see Ambert (1998).

two partners (SHIFTNOMATCH), and about 80 per cent of the sample lives in an urban area. We still find stark differences between the economic situations of men, who earn some 42,504 dollars in comparison to their wives' 19,226 dollars.

## 3.5 Econometric Results

Before turning to the results, a few specification questions need to be raised. One question concerns the importance of age and age-at-first-marriage (AFM) on divorce. Becker, *et al.* (1977) include AFM and its square in their analyses of divorce, while Zelder (1993) includes AFM. The difference in age between married couples also seems to matter (Weiss and Willis 1997; Bergstrom and Bagnoli 1993). We thus report a couple of different specifications with respect to these variables.

The literature on marriage and divorce suggests that it is not only the presence of children that affects these decisions, but their ages as well (e.g., for marriage, see Nakosteen and Zimmer, 1997; for divorce see: Becker *et al.* 1977, and Peters 1986). In order to capture the relationship between children, marriage and divorce, we include the square of the number of pre-school-aged children and school-aged children in our models.

As a result of our interest in the policy change concerning child support payments that took place in 1997, we explore the possibility that the regime change affected not only the intercept term of the models, but also that it interacted with other variables in the models. In particular, the change in the policy may have changed the incentives to have children or to purchase a house. To capture this possibility, we interacted the policy dummy variable

with other determinants of marriage and divorce to see whether these composite variables helped explain household formation and dissolution.

Critics may question the veracity of the estimated coefficient on our policy indicator variable, a dummy variable which takes on the value "one" from when the policy was first announced in 1996 and "zero" otherwise, on the grounds that it is simply picking up the trend towards more marriages or divorces. To counter this objection, we include a trend variable in our panel analysis – which indeed does affect the magnitude of the effect attributable to the policy-change dummy variable.

A final point to note before turning to the actual results concerns the difference between statistical significance and importance in the panel logit model. If the estimated coefficient is statistically significant, this simply means that the variable to which it is attached contributes to explaining the dependent variable. However, the estimated coefficient does not tell us anything about how much it contributes. An estimated coefficient may be highly statistically significant but helps explain only a miniscule part of the dependent variable. Thus, in addition to presenting the estimated coefficients and their statistical significance, we present their probability effects – i.e., we indicate how each variable affects the probability of marriage or divorce for a given "representative" individual.

### 3.5.1 The Decision to Marry

Table 4 presents the benchmark regression arising from the random effects panel logit model applied to the male and female samples separately.[32] Tables 5 and 6 present

[32] A Log likelihood Ratio test indicated significant differences between male and female singles. We estimated versions of the model with a variable indicating whether or not the individual engaged in shift-work,

the impact of changing several explanatory variables on the probability of marrying for a "representative" male and female respectively. This individual is a single male (female), Canadian-born, with high-school education, no capital gain, no investment income, 20,000 dollars of annual earnings, living in rural Ontario, and did not own a house before marriage. We calculate the basic probability of marrying for this reference individual (given in the first row of numbers) for two age levels: 30, and 40; and for two years: 1994, representing the regime before the chance in the child-support guidelines and 1998, representing the post-Guidelines regime. Reading down the tables, we basically change the dummy variables from 0 to 1. Changes in other variables are indicated in the tables.

Tables 11 and 12 present, for females and males, the estimated coefficients from the logit model conducted on each of the five years, 1994 to 1998.[33] Tables 11A and 12A present the estimated probability of marrying for the reference individual by year which arise from the logit model.

Tables 13 and 14 report the results from other four specifications of the model, again, by sex. Column (1) is the benchmark regression without the SINGLE OWN variable. Column (2) is the version which excludes the square term of age. Column (3) presents the version which adds the SHIFT information to the benchmark one, and finally column (4) presents the results from the model which includes the interactive term between the GUIDELINES and public good. Our discussion of the results focus on the benchmark model, except where it is crucial to point out important differences in the results stemming from other various specifications.

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but this has no impact statistically or otherwise on the probability of marrying.

[33] Note that data on dwelling ownership are not available for 1993.

Turning first to personal characteristics, we find that the estimated coefficients on age and its square are statistically significant, and conform to the conventional wisdom that the probability of marrying increases with age but decreases with its square, irrespective of gender. If the square term of age is omitted in the regression, the total effect of age is negative. This result holds true for the logit cross-sectional regressions. We can see the effect of age on the basic probability of marrying for our representative male in table 5 and female in table 6. In both cases, the basic probability of marrying falls dramatically from age 30 to age 40: being 30 in 1998 versus being 40 in 1998 leads to a fall of 77 per cent in the probability that a male will marry and a drop of 72 per cent in the probability that a female will marry.[34]

Whether or not the individual is an immigrant seems to matter when it comes to his or her probability of marrying. Being a new immigrant (no more than four years in the country) seems to be more important than simply having immigrated at some point in the past, especially for men for whom being an 'immigrant' as opposed to a 'new immigrant' is statistically irrelevant. It is sensible that the impact of having immigrated to Canada on the probability of marrying falls with the passage of time: one expects individuals to become assimilated into the 'norms' of the community in which they reside, with cultural dictates regarding marriage having a diminishing impact on any given individual over time. From table 4 we see that whether or not the individual is a new immigrant has a positive and statistically significant impact on the decision to marry by men and women (although the statistical significance of the estimated coefficient in the male equation is only about 10

[34] This figure is calculated as: $[(0.159 - 0.036)/0.159] * 100$ for men, and similarly for women.

per cent). Table 5 tells us the impact on the probability of getting married were our reference male a recent immigrant – his basic probability would increase five-fold in 1994. For women, the impact is a bit smaller – being a recent female immigrant at age 30 increases the base probability by about four times in 1994.[35] Table 14 shows that for females the impact of being a new immigrant on the decision to marry is always positive and statistically significant, irrespective of specification. However, for males, table 15 shows that in different specifications, the effect of being a new immigrant is not stable. The cross-sectional analysis shows similar results (tables 11 and 12).

The educational level of the individual appears not to matter when it comes to marriage, a result which compares favourably with the few empirical papers on this subject. Becker *et al.* 1977 found that the effect of education is not stable in sign or significance. Smock (1990) found that remarriage by whites does not depend upon school level, whereas for blacks it does. Nakosteen and Zimmer (1997) found that a college degree does not add to an individual's attractiveness in the marriage market. One explanation may be simply that earnings are picking up the impact of education on marriage.[36] The cross-sectional analysis paints a similar picture. Turning to the probability impact analysis, table 5 shows that four additional years (17 years in total) of education for a 30 years old man in 1994 would reduce his probability of marrying by 6 per cent in comparison to our reference man with 13 years of education. This figure is about the same for the 40 years old women. Table 6 shows that a 30 years old woman with 17 years of schooling would reduce her

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[35] Notice to calculate the impact of new immigrant both the IMMIGRANT dummy and NEW IMMIGRANT dummy go from 0 to 1.

[36] The correlation between earnings and education for male is 0.28 and for females, 0.35.

probability of marrying by 12 per cent in 1994 in comparison to our reference woman with 13 years of education.

We include three components of income from the SLID data set in our analysis: earnings, capital gains and investment income. These latter two components are indicators of an individual's wealth.[37] Turning first to these factors, we see that, by and large, capital gains and investment income have no impact on the probability of marrying by females in all specifications; for males, while capital gains have no effect, investment income does negatively affect the decision to marry.[38] Thus, wealth may render males "slightly" less inclined to marry. Earnings, by contrast, play a positive role in influencing the propensity to marry. Once again, important differences arise across the sexes. From table 5 we see that adding another 10,000 dollars to the earnings of our 30 years old reference male would increase his chances of marrying in 1998 by 37 per cent (for the 40 years old, his chances would increase 45 per cent); for a 30 years old woman, her chances would increase by 13 per cent – considerably less than her male counterpart's. For the 40 years old woman, another 10,000 dollars in earnings would increase the probability of marriage by 23 per cent. The cross-sectional results show a similar effect of earnings for both females and males except that for females the effect is statistically insignificant in 1996.

In keeping with conventional wisdom, people who live in urban areas are less likely to marry relative to their rural counterparts.[39] The logit models by cross-section find the

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[37] From the point of view of this work, the most important indicator of wealth is home ownership. We discuss the impact of this factor in the following analysis to public goods.

[38] Investment income is statistically insignificant in the fourth specification reported in table 14.

[39] Keep in mind that we are including common law in our definition of marriage so we are not simply picking up the tendency of urban couples to live together without 'marrying'.

same result (tables 11 and 12). One explanation may be that career-oriented individuals are more likely to live in an urban centre and less likely, *ceteris paribus*, to want to "settle down" with a partner. Turning to tables 5 and 6, we see that moving from a rural to an urban area would reduce the probability of marrying for a male at age 30 in 1994 by about 47 per cent; for females, this reduction would be about 59 per cent.

The SLID data set provides information on whether or not the individual lives in "owned" dwellings, although we do not know the amount of equity the individual has in the dwelling. We thus have a dichotomous variable indicating home ownership. If we believe that individuals are induced to marry in order to promote the acquisition of public goods, then it stands to reason that someone who owns his or her home prior to marriage may have less of a public-goods motivation to marry in comparison to those who do not. To address this possibility, we construct a dummy variable which takes on the value "1" if the individual owned his or her house prior to getting married (the variable continues to have the value "1" after marriage unless he or she no longer lives in owned dwellings), and "0" otherwise (SINGLE OWN). It is important to note that this variable differs slightly from the dwelling ownership (OWN) variable, *per se*, in the following way: the SINGLE OWN variable takes on the value 1 only if the individual owned his or her dwellings prior to marriage, whereas OWN takes on the value 1 at whatever point the individual becomes a house owner be it before or after marriage. These two variables are thus highly correlated, with a correlation coefficient of 0.98.

From our results reported in columns (2), (3) and (4) of tables 13 and 14, it is very clear that owning a home when single exerts a negative impact on the probability of marry-

ing – a result which conforms with the 'public-goods' motivation for marriage, irrespective of specification. Tables 5 and 6 provide the information regarding the impact for men and women of SINGLEOWN on the probability of marriage. Our 30 years old reference male would decrease his probability of marriage by over 80 per cent were he to own a house when single. For women this number is a bit lower, but still well over 70 per cent. It certainly appears that home ownership is one motivator for marriage. The logit cross-sectional analysis paints a similar picture.

We also estimated versions of the benchmark model without the SINGLE OWN variable as reported in column (1) of table 13 and 14. We observe that for the single male education has a positive impact on the decision to marry and it is statistically significant at the 10 percent level after excluding the SINGLE OWN dummy. For single females education still has negative impact on the decision to marry and is statistically significant after excluding the SINGLE OWN dummy. The GUIDELINES become statistically significant at the 10 percent level for single males, while it is still statistically insignificant for single females.[40]

We turn now to an examination of how the changes to the law governing child-support have affected the decision to marry. From our theoretical analysis, the new child-support guidelines may engender two important influences on household formation and dissolution. On the one hand, for people contemplating marriage, the guidelines reduce much of the uncertainty regarding the support payments accorded children in the event of separation; they also reduce the legal costs associated with seeking a child-support order. By rendering

[40] Tables 17 and 18 present the probability impacts for column (1) of table 13 and 14 respectively.

divorce less costly for custodial parent, these two influences may render marriage more desirable, *ceteris paribus*. On the other hand, the guidelines represent an increase in support payments received by most custodial parents rendering divorce more costly for the non-custodial parent – making divorce less attractive for some, *ceteris paribus*. Overall, the impact of these two effects on the decision to marry is not at all clear, *ex ante*.

It is worth recalling that the variable GUIDELINES takes on the value "1" in 1996, the year in which the child-support guidelines were announced and onwards. We have also included a time variable in our analysis (TREND), since it became clear that there seemed to be an upward trend in marriages over time, for reasons that are perhaps not captured by the model.[41] Without this variable, the guidelines dummy could well be picking up the trend in the data which would hamper our interpretation of its estimated coefficient. And indeed, this is what we found. When the trend is put into the analysis, the statistical significance of the guidelines variable is very low, indicating that the guidelines are not having an impact on the probability of marriage. In many respects, this result is not surprising, given the competing influences of child-support on this decision; perhaps these influences are simply canceling each other out.

We examined whether home ownership while single interacted with the new child-support policy had an impact on marriage. To explore the idea that the new regime rendered marriage less desirable, SINGLE OWN was interacted with GUIDELINES. From tables 13 and 14 we see that the interactive term is positive and statistically significant for men and women: after the new guidelines regime went into effect, the impact of owning a

[41] We also run versions of the model with the square term of TREND variable and it is statistically insignificant, and therefore are not reported here.

home prior to marriage falls dramatically. It would seem that the reduction in the costs of divorce arising from the new guidelines mitigate the negative impact of home ownership while single on the decision to marry.

Finally it is interesting to note that for males the region of residence matters, whereas for females it does not. Males living in all regions except British Columbia are more likely to marry in comparison to their Ontario counterparts, irrespective of specifications; for women, by contrast, region of residence has no statistical influence on their probability of marrying in most cases.

### 3.5.2 The Decision to Divorce

Before proceeding, it is appropriate to say a few words about the legal regime governing divorce in Canada and how it may affect the likelihood of divorce. Since 1986, divorce is governed by no-fault rules, meaning that any individual may file for divorce *without* the consent of his or her partner. Divorce, therefore, can be *unilaterally* initiated and obtained. This regime is in stark contrast to a fault (bilateral) system in which parties petitioning for divorce have to show (and ultimately agree on) cause for divorce. In such a regime, divorce depends upon individual and household characteristics; furthermore, since the partner not wanting the divorce has "bargaining rights" over the one wanting the divorce, we expect some sort of redistribution of marital wealth from the petitioner in order to encourage the desired outcome. Within a no-fault regime, the "threat" to divorce unilaterally is credible,

which may affect the allocation of marital goods during the marriage.[42] Thus, while it takes both partners to agree to marriage, it only requires one partner to end it.

Many specifications of the empirical model of divorce are suggested by the extensive literature on the subject. One issue concerns how to treat a person's age, and whether it is the age at which the individual first married that is of importance in determining the probability of divorce (see, for instance, table A1 in the appendix). Furthermore, is it age at first marriage which affects divorce, or is it the duration of the marriage itself? To make the water even murkier, the results reported in the literature regarding the impact of age on divorce seem to depend upon the specification employed (e.g., Becker *et al.* 1977, Zelder 1989). Becker *et al.* (1977) view the age at first marriage as a proxy of searching cost: the older an individual marries, the higher his or her searching costs. But the older the individual, the shorter the duration of marriage at any given point in time. Because our sample is composed of married couples, we have the additional problem of determining whose age matters when it comes to predicting divorce. As a consequence, we present the results with two different age specifications. Column (1) of table 7, the benchmark regression, reports the results when the age of the husband (AGEM) is included in the regression along with the age of the husband when first married (AFMM) and the age of the wife when first married (AFMF). In column (2) we present the results when the husband's age is included along with the difference in the ages between the two partners (male minus female) plus its square. Column (3) is the same as column (2) except that,

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[42] Several authors have modeled the impact of divorce regimes on divorce: see, for instance, Brinig and Carbone 1988 and Allen 1990.

rather than entering years of schooling for the husband and wife separately, the difference in education between these two is included as an explanatory variable.

Table 8 presents the impact of changing various explanatory variables on the probability of divorcing by a representative couple. This couple, in keeping more or less with the "average" of our sample, is one where the husband is 40 years of age and was married at age 25, his wife was married at age 23 (the husband is two years older than his wife), neither of them is an immigrant, he earns 40,000 dollars annually whereas she earns 20,000 dollars, they do not own a dwelling, they have one pre-school aged child and one school-aged child, and they work the same shift and live in urban Ontario.

Table 16 presents different extensions to the benchmark regression. Column (1), (2) and (3) of table 16 examine whether home ownership as well as pre-school aged children interacted with the new child-support policy had an impact on divorce. Column (4) of table 16 is a specification excluding the square term of the number of pre-school aged children as well as school-aged children. Estimates of the decision to divorce arising from a year-by-year estimation procedure (table 15) will also be discussed in order to develop a richer picture of the factors which influence this decision.

Now we turn to the analysis to the estimation results. We focus largely on the results from table 7. The age of the husband has a consistently negative impact on divorce.[43] In column (1) we see that the age of the wife when first married (AFMF) has a negative impact on divorce – a result consistent with our findings in columns (2) and (3) in which the difference in the age at first marriage between males and females is found to positively

[43] We could not include the age of the wife as well as the age of the husband in the regressions because they were perfectly correlated with each other.

influence divorce. It also conforms to the results reported in Becker *et al.* 1977. Not only does the difference in age at first married affect divorce, but so does it square. It would seem that the older the husband is relative to his wife, the higher the probability that their union will result in divorce.

To get a sense of the impact of age on divorce, we turn to table 8. The probability effects stemming from the three specifications in table 7 are very similar; we thus focus on the first specification for the sake of brevity. If five years are added to the husband's age, then his probability of divorcing will be reduced by about 20 per cent over the reference probability. If the difference in the couple's age at first marriage increases from two to five years, the probability of divorcing increases by 46 per cent. Finally, from table 8 we see that if the woman were five years older than the man at the time of marriage, the probability of divorcing would fall by 55 per cent. Who is older within the family seems to matter in the decision to divorce. It is also consistent to what Weiss and Willis (1997) find: if the wife is older than the husband, the couple tends to have a more stable marriage than otherwise.

When we analyze each cross-section separately (table 15), we find that age of husband, husband's AFM and wife's AFM are statistically significant determinants of the probability to divorce during the years 1995 to 1998 – with a sign pattern identical to that displayed in the panel models, except in 1994. Namely, divorce falls with husband's age, rises with his AFM and falls with her AFM.

To see how educational attainment affects divorce, we use the level of education of the husband and wife in columns (1) and (2) and the difference in educational levels in

column (3) of table 7. In all cases, education does not appear to be playing a direct role in divorce; once again, however, it is quite likely that the impact of education is being captured by the earnings variable. The findings concerning education and divorce in the literature are quite mixed: Peters (1986) finds that the educational level of women has a negative impact on the probability of divorce, Becker *et al.* (1977) finds that education is not a stable predictor of divorce, while Kidd (1995) reports that divorce increases with education.

If the husband is an immigrant, this has a consistently negative and statistically significant impact on the probability of divorce. From table 8 we see that if the husband is an immigrant, this reduces the probability of our reference couple divorcing by 46 per cent, irrespective of the year in question. If the wife is an immigrant, the effect on divorce is positive but not statistically significant. Kidd (1995) finds that Australian-born individuals have a higher probability of divorce than do immigrants to Australia. He does not distinguish between males and females.

The earnings of the husband never matter when it comes to determining the probability of divorce, whereas the earnings of the wife always matter! As female earnings increase, the probability of divorce rises. This result is in keeping with the often espoused view that economic independence by women is an important pre-cursor to divorce.[44] To see just how important earnings are to the decision to divorce, we turn to table 8. If the wife's annual earnings were to rise from 20,000 to 30,000 dollars, the probability that the couple divorces would rise by 12 per cent. Becker *et al.* (1977) also find differences across

[44] Peters (1993) argues that the expected financial consequences post-divorce affect the decision to divorce; Weiss and Willis (1997) show that the wife's earning capacity has a destabilizing effect on marriage.

the sexes: they report that increases in the expected earnings of males reduce the probability of first divorce, while the opposite is true for women. Weiss and Willis (1997) find that an "unexpected" increase in the husband's earning capacity reduces the probability of divorce, while an unexpected increase in the earning capacity of the wife increases the probability of divorce.

Referring once again to the year-by-year logits provided in table 15, we see that wife's earnings exert a positive and statistically significant impact on the probability of divorce from 1997 onwards. Husband's earnings never matter. Perhaps the increased certainty arising from the guidelines renders the wife's income a more important determinant of divorce.

In the theoretical model developed in essay one, one of the factors leading to marital instability was income inequality: the more unequal the contribution of each partner to household earnings, the more likely divorce would arise. This result arises in part from the fact that divorce is unilaterally initiated. To try to get a richer sense of how inequality may matter, we take advantage of the time dimension of the SLID data set to look at the earnings contributions of men and women to household earnings before and after divorce, in the following way.[45] Starting from a sample of all individuals in their first marriage in 1993, we look at the percentage contribution of each individual to household earnings in year $t$, and then establish who, among this group, separated in year $t+1$. We take the group of individuals who separated in $t+1$ and calculate their average contributions to

[45] Remember that, as soon as our married couple separate, they are removed from our sample. We cannot easily track earnings of each of the two partners before and after separation. We did try to include the earnings difference between the two individuals in our regression analysis; its statistical significance was very low.

household earnings in period $t$, and we compare this average to the average contribution to household earnings in period $t$ of the group of individuals who were still married in period $t+1$. We perform this exercise each year 1993-1998 (in fact, because of the forward looking of the process, we can only compare earnings contributions until the year 1997). The average percentage contributions to household earnings for the married and separated (next period) females and males are reported in tables 9 and 10. We also report in the last column whether the difference between the average contribution of the married and separated groups is statistically significant based on the t statistics.

From tables 9 and 10 we see that whenever the difference between the average contributions to the household for the married group is different than that of the separated group, the contribution in the separated group is always higher. For instance, for women who separated in 1998, their average contribution to household earnings was 43.74 per cent, as opposed to 25.75 per cent for those women who remained married. For men who separated in 1998, their average contribution to household earnings was 65.30 per cent, as opposed to 54.14 per cent for those men who remained married. While various factors may be influencing earnings in these cases, these figures are consistent with the view that the incidence of divorce increases with the economic contributions of men and women to the household. It is interesting to note that the variability over the years across the earnings contributions of the group that stays married is very small, but varies considerably over the years across men and women. For the group of women who stay married, they contribute 26 – 27 per cent of household earnings, while for their male counterparts, they contribute 54-58 per cent.

Residing in an urban community is always associated with a higher probability of divorce, although its statistical significance is rather weak (at best 10 per cent for the specification reported in column (1) of table 7). From table 8 we see that moving from an urban to a rural community would result in an important fall – some 35 per cent – in the probability of divorcing. This result accords with the conventional wisdom that people who live in a rural community are more likely to marry and less likely to divorce. Sociologists offer many reasons why this might be the case (e.g., Stella 1996), including the pace of life, the availability of alternatives, and the fact that in small communities, it is much more difficult to operate anonymously, and hence community norms impose stronger constraints on private behaviour.

Turning now to the public good reasons to divorce (or not), we examine first the importance of children. It has been clearly established in the literature that the presence of children reduces the probability of divorce: Becker, *et al.* (1977) show that the presence of young children reduces the probability of marital dissolution and increases the changes of remarriage should divorce occur. Peters (1986) highlights the importance of children in affecting the incidence of divorce of women, while Zelder (1993) makes a public-goods argument as to why children reduce the chance of marital dissolution.

Our analysis includes a measure of the number of pre-school aged children, as well the number of school-aged children in the household; we also include squared terms for each of these variables to capture the potentially more complicated relationship between the number of children and divorce. Our results clearly confirm that the presence and number of children reduce significantly the probability of divorce. Whereas the estimated

coefficient on the squared term of the pre-school aged children variable is statistically insignificant, the estimated coefficient on the squared term of the school-aged children variable is positive and statistically strong. This result suggests that the relationship between school-aged children and divorce is non-linear. One possibility is that the number of school-aged children is capturing, in part, the duration of the marriage, and divorce is typically a decreasing function of duration. Table 8 provides a measure of the overall impact of children on the expected probability of divorce by our representative couple. If they were to have one more pre-school aged child, the probability of divorce would fall by 57 per cent; one more school-aged child would decrease the probability of divorce by 60 per cent. The cross-sectional analysis reported in table 15 reveals a similar story.

One measure of "companionship" within a marriage is the amount of time the couple has together. To get an idea of this time, we included in the analysis whether or not the partners worked the same (or similar) hours.[46] The variable SHIFTNOMATCH is a dichotomous variable taking on the value one if the husband works a different shift from the wife. From table 7 we see that working in different shifts has a positive and statistically significant impact on divorce. Looking at table 8, were our reference couple to work in different shifts, this would almost double their chances of divorce – confirming that companionship does matter for marital stability.[47]

Another important public good within a marriage is home ownership. The estimation results reported in table 7 shows that owning a home exerts a consistently negative impact on the probability of divorcing. Indeed, were our reference couple home owners, their

[46] We thank Miles Corak for suggesting that we use this variable to proxy companionship.

[47] We have not been able to find any other papers that include shift-work as a determinant of divorce.

probability of divorcing would fall by 85 per cent. The cross-sectional logits accord also with this conclusion. The result that the sharing of public goods provides an impetus to remain married appears to be very robust to specification and model employed.

Someone may argue that couples in "stable" marriages are more likely to invest in a home. However, it may be more accurate to say that couples with a relatively high probability of divorce are more likely to invest 'less' in a home while they still want to 'own' a family house. The SLID data set reveals that around 89 percent of married couples own a dwelling.

Finally, we turn to the impact of the new Child-Support Guidelines on the probability of divorce. In table 7 and 8, we find that their effect is positive, with a probability value of about 7 per cent. Only a few empirical papers have looked at the impact of child support on divorce, *per se*; a gap largely attributable to the lack of appropriate data. Nixon (1997), for instance, using data from the Current Population Survey in the United States, looks at how enforcement of child support payment affects divorce and finds that the stronger the enforcement, the lower the probability of divorce. By contrast, Furstenberg, *et al.* (1995) fail to find evidence that greater child support enforcement discourages divorce – again using US data. Peters (1993) addresses the issue somewhat tangentially in that she looks at the financial opportunity cost of divorce and the decision to divorce – and finds that the greater the financial cost, the lower the probability of divorce. The fact that the guidelines represent for most custodial parents an increase in their share of household revenues upon separation, coupled with the fact that divorce can be unilaterally obtained, means that for many people, divorce is a better alternative than staying in the marriage,

*ceteris paribus*. The impact of the guidelines on divorce is important. From table 8 we see that the introduction of the guidelines would increase the probability of divorce by our reference couple by 91 per cent.

We also interacted the new child-support policy regime with the number of pre-school aged children and living in owned dwellings. Since the new regime specifically concerns children, it is possible that the impact of young children on divorce changed as a result of new regime. The results from column (1), (2) and (3) in table 16 indicate that this did not happen. It is also possible that public-good motivation to stay married arising from home ownership might change with changes in the cost associated with divorce, i.e., via the new guidelines. Column (3) in table 16 reveals that the impact of home ownership on divorce was attenuated after the guidelines are put in place – with a positive but insignificant estimated coefficient on the interactive term.

Finally, we examine the logit equations for the decision to divorce on cross section of our sample (table 15). Table 15A provides the predicted probability of divorcing by the reference couple. We can see quite clearly that in general the estimated probability of divorce is decreasing over time, although it is increased dramatically from the year of 1995 to 1996. Once again, caution needs to be exercised when interpreting these predicted probabilities over time, as the cross-sectional model, by definition, has no ability to account for time trends in the population.

## 3.6 Summary and Conclusions

Aside from being the first paper to analyze marital formation and dissolution using the SLID data set, this research is designed to look into how 'marital' public goods – primarily children and houses – and child support policy affect the decisions to marry and divorce. One of the important features of this micro data set is the fact that we could match up the couples within a marriage in order to determine what factors affected the probability of their divorcing.

This research provides support for the notion that the sharing of public goods provides an important impetus for marriage and marital stability. Our results indicate that owning a home prior to marriage has a strongly negative impact on the decision to marry – a result that is consistent with the idea that people marry in order to share public goods. Clearly, if a person already has access to one of these goods – owned dwelling – then the incentive to marry is diminished. Owning a home while married, by contrast, provides a strong incentive to stay married: again, the argument is that neither partner wants to relinquish the benefits associated with this marital good. Indeed, home ownership almost cuts the predicted divorce rate in half for our reference individual. Our paper was also able to confirm the importance of companionship – as proxied by information on work shifts – on marital stability. If a couple works different shifts, presumably spending less time together, it would almost double their chances of divorce. Children, another important 'marital specific' public good, also have a significant impact on the decision to divorce. The presence of children, especially pre-school aged children, is a strong deterrent to divorce.

Overall, therefore, the empirical analysis supports the idea that public goods within a marriage provide an incentive to marry, and to stay married. It substantiates the main idea highlighted in the first and second essay of this thesis in which public goods play an important role in encouraging marriage and, depending upon how they are allocated post-marriage, in determining for how long the marriage will last.

This paper is also the first to be able to look at how the 1997 Child-Support Guidelines may have affected marriage and divorce. We find reasonably strong support for the notion that the decision to marry is not affected by this policy while the decision to divorce is. This latter result seems sensible for two reasons: the fact that the guidelines represent an increase in the expected payments going to many (but not all) custodial households means that the financial consequences of divorce are attenuated by this policy; second, the guidelines render clearer the cost associated with divorce. Relative to the pre-guidelines situation, the first effect would provide an 'incentive' for the custodial parent to seek divorce while for the non-custodial parent to eschew it. However, in a unilateral divorce regime, such as exists in Canada, this effect would increase the probability of divorcing in general, *ceteris paribus*. The second effect of reducing the uncertainty associated with child-support payments post-marriage would also serve to 'encourage' more divorces *relative to the previous regime*. The expected impact on marriage of the guidelines is much less straightforward insofar as, to the extent that the expected probabilities of divorce in the new regime increase, this may lead some people to avoid marriage in the first place.

One avenue for future research suggested by this work, as well as by the existing literature, is to regard child-bearing as endogenous – dependent upon, among other things,

the probability that the individual will divorce as well as the child-support guidelines. Of course, if we think that the decision to bear children is affected by the expected probability of divorce then the specification of the divorce model in this chapter is flawed: further research into this question is necessary in order to untangle the relationship between marriage, children and divorce. In the meantime, we justify the inclusion of children in the analysis on the basis of the existing literature on the subject.

# 3.A Tables and Appendix

**Table 1** Definition of Variables

| VARIABLE | DEFINITION |
|---|---|
| MARRIED | Equal to 1 if married 0 otherwise |
| DIVORCE | Equal to 1 if divorced 0 otherwise |
| AGE | Person's age as of December 31 of the reference year |
| AGEM | Age of the husband |
| AGEF | Age of the wife |
| AFMM (F) | Husband's ( wife's) age at first marriage |
| MALE | Sex of respondent (equal to one for male) |
| IMMIGRANT | Equal to one if individual is an immigrant 0 otherwise |
| NEW IMMIGRANT | Flag indicating if person has been an immigrant no more than three years as of December 31 of the reference year |
| EDUCATION | Number of years of schooling completed by person (full-time equivalents). |
| CAPITAL GAIN | Taxable capital gains |
| INVESTMENT INCOME | Investment income for the reference year. Includes actual amount of dividends reported, interest and other investment income, and interest income from outside Canada. |
| EARNINGS | Total employment income or earnings for the reference year which equals wages, salaries plus farm self-employment net income and non-farm self-employment income. |
| URBAN | Flag indicating if this household was in an urban or rural area as of December 31 of the reference year (=1 if urban) |
| SHIFT | Equal to one if working shift |
| SHIFT NO MATCH | Equal to one if a couple works in different shifts |
| OWN | Ownership status of the dwelling in which the household lives in as of December 31 of the reference year (=1 if owned by a member of the household) |

**Table 1** Definition of Variables (Continued)

| VARIABLE | DEFINITION |
|---|---|
| SINGLE OWN | Equal to one if individuals own the dwelling before the marriage 0 otherwise |
| PRE-SCHOOL | The number of pre-school aged children(birth, step, adopted, foster) (aged 0 to 5) living in the household as of December 31 of the reference year |
| SCHOOL AGE | The number of school aged children(birth, step, adopted, foster) (aged 6 to 17) living in the household as of December 31 of the reference year |
| GUIDELINES | Child Support Policy variable: 1 from 1996, 0 before 1996 |
| ATLANTIC | Equal to 1 if living in Atlantic provinces |
| QUEBEC | Equal to 1 if living in Quebec |
| ONTARIO | Equal to 1 if living in Ontario |
| PRAIRIE | Equal to 1 if living in Prairie provinces |
| BC | Equal to 1 if living in British Columbia |
| ILGWT26 | Longitudinal weight for the person for the reference year |

## Table 2: Descriptive Statistics for Single Sample, N=5,000[1]

| | Single (including common-law) sample | | | | | |
|---|---|---|---|---|---|---|
| | Female | | | Male | | |
| Variable | Obs | Mean | Std. Dev. | Obs | Mean | Std. Dev. |
| **PERSONAL CHAR** | | | | | | |
| Age | 11574 | 28 | 9.13 | 14105 | 28 | 8.46 |
| New immigrant | 11354 | 0.004 | 0.06 | 13838 | 0.008 | 0.09 |
| Immigrant | 11354 | 0.117 | 0.32 | 13838 | 0.13 | 0.33 |
| Education | 11219 | 14.02 | 3.00 | 13704 | 13.60 | 3.37 |
| Capital gain | 11433 | 54 | 2323.78 | 13896 | 103 | 2869.26 |
| Earnings | 11413 | 15135 | 16826.35 | 13859 | 18407 | 19245.65 |
| Investment income | 11433 | 240 | 2086.33 | 13896 | 279 | 2070.21 |
| Urban | 11574 | 0.89 | 0.31 | 14105 | 0.86 | 0.35 |
| **PUBLIC GOODS** | | | | | | |
| Shift | 11574 | 0.13 | 0.34 | 14105 | 0.15 | 0.35 |
| Pre-school | 11574 | 0.08 | 0.31 | 14105 | 0.02 | 0.15 |
| School age | 11574 | 0.08 | 0.35 | 14105 | 0.02 | 0.18 |
| Single own | 9019 | 0.53 | 0.50 | 11503 | 0.60 | 0.49 |
| **PUBLIC POLICY** | | | | | | |
| Guidelines | 11574 | 0.44 | 0.50 | 14105 | 0.46 | 0.50 |
| Atlantic | 11574 | 0.09 | 0.28 | 14105 | 0.08 | 0.27 |
| Quebec | 11574 | 0.25 | 0.43 | 14105 | 0.25 | 0.43 |
| Ontario | 11574 | 0.38 | 0.49 | 14105 | 0.38 | 0.49 |
| Prairie | 11574 | 0.15 | 0.36 | 14105 | 0.16 | 0.37 |
| BC | 11574 | 0.13 | 0.34 | 14105 | 0.13 | 0.33 |
| Sample size | 2314 | | | 2686 | | |

[1] The means are computed using the Statistics Canada longitudinal weights and are averaged over the panel.

**Table 3: Descriptive Statistics for Matched Couple Sample, N=3,753[2]**

| Variable | Obs | Mean | Std. Dev. |
|---|---|---|---|
| **PERSONAL CHAR** | | | |
| **AgeM** | 22143 | 42 | 8.23 |
| **AgeF** | 22143 | 40 | 8.11 |
| **AFMM** | 22035 | 25 | 3.82 |
| **AFMF** | 21821 | 23 | 3.61 |
| **ImmigrantM** | 21828 | 0.18 | 0.38 |
| **ImmigrantF** | 21933 | 0.17 | 0.37 |
| **EducationM** | 21666 | 13.48 | 3.57 |
| **EducationF** | 21569 | 13.31 | 3.07 |
| **EarningM** | 22072 | 42504 | 40183.58 |
| **EearningF** | 22076 | 19226 | 20140.84 |
| **Urban** | 22143 | 0.80 | 0.40 |
| **PUBLIC GOODS** | | | |
| **Shift no match** | 22143 | 0.29 | 0.45 |
| **Pre-school** | 22143 | 0.40 | 0.72 |
| **School-age** | 22143 | 0.96 | 1.08 |
| **Dwelling ownership** | 18280 | 0.89 | 0.32 |
| **PUBLIC POLICY** | | | |
| **Guidelines** | 22143 | 0.49 | 0.50 |
| **Atlantic** | 22143 | 0.10 | 0.30 |
| **Quebec** | 22143 | 0.23 | 0.42 |
| **Ontario** | 22143 | 0.39 | 0.49 |
| **Prairie** | 22143 | 0.16 | 0.37 |
| **BC** | 22143 | 0.12 | 0.33 |

[2] The means are computed using the Statistics Canada longitudinal weights and are averaged over the panel.

**Table 4: Random Effects Panel Logit Model, Decision to Marry (y=1 if married, 0 otherwise)**

| | MALE | | FEMALE | |
|---|---|---|---|---|
| | Coef. | z | Coef. | z |
| **PERSON CHAR** | | | | |
| Age | 1.009 | 6.14 | 0.903 | 6.19 |
| Age^2 | -1.672 | -6.39 | -1.540 | -6.57 |
| New immigrant | 1.764 | 1.62 | 3.218 | 3.67 |
| Immigrant | 0.182 | 0.62 | 0.474 | 1.85 |
| Education | -0.017 | -0.51 | -0.040 | -1.33 |
| Capital gain | 0.028 | 1.26 | -0.006 | -0.14 |
| Earnings | 0.039 | 6.68 | 0.024 | 4.2 |
| Investment income | -0.108 | -1.74 | 0.008 | 0.24 |
| Urban | -0.644 | -2.62 | -1.027 | -4.62 |
| **PUBLIC GOOD** | | | | |
| Single own | -2.256 | -8.37 | -1.778 | -8.36 |
| **PUBLIC POLICY** | | | | |
| Guidelines | 0.181 | 0.78 | 0.216 | 1.06 |
| Trend | 0.553 | 3.89 | 0.316 | 2.84 |
| Atlantic | 0.810 | 1.89 | -0.053 | -0.18 |
| Quebec | 0.436 | 1.64 | 0.322 | 1.59 |
| Prairie | 0.537 | 1.89 | 0.142 | 0.62 |
| BC | -0.358 | -1.15 | 0.093 | 0.4 |
| constant | -71.622 | -4.71 | -44.328 | -3.74 |
| Sample Size (93) | 2686 | | 2314 | |
| Sample Size (94) | 2581 | | 2195 | |
| Sample Size (95) | 2438 | | 2031 | |
| Sample Size (96) | 2290 | | 1850 | |
| Sample Size (97) | 2122 | | 1655 | |
| Sample Size (98) | 1988 | | 1529 | |
| Log likelihood | -2165.776 | | -2192.262 | |

**Table 5: Probability Impact on Reference individual: Single male, non-immigrant, with 13 years of schooling, no capital gain, no investment income, annual earnings 20,000 dollars, living in rural Ontario, did not own dwelling before marriage**

| | AGE=30 | | | | AGE=40 | | | |
|---|---|---|---|---|---|---|---|---|
| | year=94 | | year=98 | | year=94 | | year=98 | |
| **probability of marriage** | 0.020 | | 0.159 | | 0.004 | | 0.036 | |
| **New immigrant[c]** | 0.126 | 524% | 0.569 | 259% | 0.028 | 583% | 0.209 | 475% |
| **Immigrant** | 0.024 | 20% | 0.185 | 16% | 0.005 | 20% | 0.043 | 19% |
| **+4 yrs education** | 0.019 | -6% | 0.150 | -5% | 0.004 | -6% | 0.034 | -6% |
| **+50 capital gain** | 0.021 | 1% | 0.161 | 1% | 0.004 | 1% | 0.037 | 1% |
| **+10K earning[a]** | 0.030 | 46% | 0.218 | 37% | 0.006 | 47% | 0.053 | 45% |
| **+50 investment income[c]** | 0.019 | -5% | 0.152 | -4% | 0.004 | -5% | 0.034 | -5% |
| **Urban[a]** | 0.011 | -47% | 0.090 | -43% | 0.002 | -47% | 0.019 | -47% |
| **Single own[a]** | 0.002 | -89% | 0.019 | -88% | 4.4E-04 | -89% | 0.004 | -89% |
| **Guidelines** | 0.024 | 19% | 0.184 | 16% | 0.005 | 20% | 0.043 | 19% |
| **Atlantic[c]** | 0.044 | 119% | 0.298 | 88% | 0.009 | 124% | 0.078 | 115% |
| **Quebec[c]** | 0.031 | 53% | 0.226 | 42% | 0.006 | 54% | 0.055 | 52% |
| **Prairie[c]** | 0.034 | 69% | 0.244 | 54% | 0.007 | 71% | 0.061 | 67% |
| **BC** | 0.014 | -30% | 0.116 | -27% | 0.003 | -30% | 0.026 | -29% |

a = estimated coefficient significant at 1 percent level
b = estimated coefficient significant at 5 percent level
c = estimated coefficient significant at 10 percent level

**Table 6: Probability Impact on Reference individual: Single female, non-immigrant, with 13 years of schooling, no capital gain, no investment income, annual earnings 20,000 dollars, living in rural Ontario, did not own dwelling before marriage**

| | AGE=30 | | | | AGE=40 | | | |
|---|---|---|---|---|---|---|---|---|
| | year=94 | | year=98 | | year=94 | | year=98 | |
| **probability of marriage** | 0.188 | | 0.450 | | 0.039 | | 0.124 | |
| **New immigrant[a]** | 0.903 | 381% | 0.970 | 116% | 0.617 | 1497% | 0.851 | 584% |
| **Immigrant[c]** | 0.271 | 44% | 0.568 | 26% | 0.061 | 57% | 0.186 | 49% |
| **+4 yrs education** | 0.165 | -12% | 0.411 | -9% | 0.033 | -14% | 0.108 | -13% |
| **+50 capital gain** | 0.187 | -0.2% | 0.449 | -0.2% | 0.039 | -0.3% | 0.124 | -0.3% |
| **+10K earning[a]** | 0.227 | 21% | 0.509 | 13% | 0.049 | 26% | 0.153 | 23% |
| **+50 investment income** | 0.188 | 0.3% | 0.451 | 0.2% | 0.039 | 0.4% | 0.125 | 0.4% |
| **Urban[a]** | 0.076 | -59% | 0.226 | -50% | 0.014 | -63% | 0.048 | -61% |
| **Single own[a]** | 0.038 | -80% | 0.121 | -73% | 0.007 | -83% | 0.023 | -81% |
| **Guidelines** | 0.223 | 19% | 0.504 | 12% | 0.048 | 23% | 0.150 | 21% |
| **Atlantic** | 0.180 | -4% | 0.437 | -3% | 0.037 | -5% | 0.119 | -5% |
| **Quebec** | 0.242 | 29% | 0.530 | 18% | 0.053 | 36% | 0.164 | 32% |
| **Prairie** | 0.210 | 12% | 0.485 | 8% | 0.044 | 15% | 0.141 | 13% |
| **BC** | 0.202 | 8% | 0.473 | 5% | 0.042 | 9% | 0.135 | 8% |

a = estimated coefficient significant at 1 percent level
b = estimated coefficient significant at 5 percent level
c = estimated coefficient significant at 10 percent level

**Table 7: Random Effects Panel Logit Model, Decision to divorce (y=1 if divorced, 0 otherwise)**

| | 1 | | 2 | | 3 | |
|---|---|---|---|---|---|---|
| | **Coef.** | **z** | **Coef.** | **z** | **Coef.** | **z** |
| **PERSONAL CHAR** | | | | | | |
| **Husband's age** | -0.046 | -3.67 | -0.047 | -3.74 | -0.046 | -3.74 |
| **Husband's afm** | 0.131 | 4.07 | | | | |
| **Wife's afm** | -0.115 | -3.16 | | | | |
| **afm difference (m-f)** | | | 0.062 | 1.67 | 0.062 | 1.66 |
| **afm difference^2** | | | 0.009 | 2.58 | 0.009 | 2.58 |
| **Education difference** | | | | | 0.036 | 1.33 |
| **Husband's education** | 0.030 | 0.99 | 0.030 | 1 | | |
| **Wife's education** | -0.050 | -1.38 | -0.047 | -1.31 | | |
| **Husband immigrant or not** | -0.609 | -1.99 | -0.625 | -2.03 | -0.625 | -2.03 |
| **Wife immigrant or not** | 0.407 | 1.28 | 0.427 | 1.36 | 0.426 | 1.36 |
| **Husband's earning** | 2.33E-04 | 0.08 | 1.58E-04 | 0.05 | -1.80E-04 | -0.06 |
| **Wife earning** | 0.012 | 2.54 | 0.012 | 2.73 | 0.012 | 2.68 |
| **Urban** | 0.439 | 1.63 | 0.415 | 1.54 | 0.402 | 1.5 |
| **PUBLIC GOODS** | | | | | | |
| **Dwelling ownership** | -1.886 | -9.11 | -1.862 | -8.97 | -1.864 | -8.96 |
| **Pre-school children** | -1.672 | -3.39 | -1.659 | -3.36 | -1.661 | -3.36 |
| **School age children** | -1.615 | -6.78 | -1.627 | -6.76 | -1.620 | -6.74 |
| **pre-school^2** | 0.271 | 1.16 | 0.267 | 1.14 | 0.268 | 1.14 |
| **school age^2** | 0.231 | 3.57 | 0.232 | 3.49 | 0.230 | 3.46 |
| **Shift no match** | 0.678 | 3.55 | 0.668 | 3.48 | 0.675 | 3.52 |
| **PUBLIC POLICY** | | | | | | |
| **Guidelines** | 0.648 | 1.79 | 0.645 | 1.78 | 0.642 | 1.78 |
| **Trend** | -0.113 | -0.9 | -0.110 | -0.87 | -0.112 | -0.89 |
| **Atlantic** | 0.438 | 1.38 | 0.411 | 1.29 | 0.411 | 1.29 |
| **Québec** | 0.334 | 1.37 | 0.330 | 1.36 | 0.333 | 1.37 |
| **Prairie** | 0.102 | 0.35 | 0.109 | 0.37 | 0.112 | 0.38 |
| **BC** | 0.073 | 0.22 | 0.083 | 0.26 | 0.086 | 0.26 |
| **constant** | 8.506 | 0.71 | 8.595 | 0.72 | 8.524 | 0.72 |
| **Sample Size (93)** | 3753 | | | | | |
| **Sample Size (94)** | 3746 | | | | | |
| **Sample Size (95)** | 3716 | | | | | |
| **Sample Size (96)** | 3685 | | | | | |
| **Sample Size (97)** | 3639 | | | | | |
| **Sample Size (98)** | 3604 | | | | | |
| **Log likelihood** | -638.931 | | -636.465 | | -636.572 | |

**Table 8: Probability Impact on Reference couple: Husband is at age 40 and got married at age 25, wife's age at first marriage was 23, both have 13 years of schooling, both are non-immigrant, husband's earnings are 40,000 dollars annually, wife's earnings are 20,000 dollars annually, the couple does not own a dwelling, they have one pre-school age child and one school-age child; they work a same shift; and they live in urban Ontario. (Specification No. 1)**

| | year=94 | | year=98 | |
|---|---|---|---|---|
| **probability of divorce** | 0.003 | | 0.002 | |
| **5 more years at husband's age**[a] | 0.003 | -20% | 0.002 | -20% |
| **3 more years at husband's age at first marriage**[a] | 0.005 | 46% | 0.003 | 46% |
| **Wife was 5 more years older than husband when they were married**[a] | 0.001 | -55% | 0.001 | -55% |
| **4 more years schooling of husband** | 0.004 | 13% | 0.002 | 13% |
| **4 more years schooling of wife** | 0.003 | -18% | 0.002 | -18% |
| **4 more years of schooling of husband and wife** | 0.003 | -8% | 0.002 | -8% |
| **Husband is an immigrant**[b] | 0.002 | -46% | 0.001 | -46% |
| **Wife is an immigrant** | 0.005 | 50% | 0.003 | 50% |
| **Both are immigrants** | 0.003 | -18% | 0.002 | -18% |
| **10K more husband's earning** | 0.003 | 0.2% | 0.002 | 0.2% |
| **10K more wife's earning**[a] | 0.004 | 12% | 0.002 | 12% |
| **Rural**[c] | 0.002 | -35% | 0.001 | -35% |
| **Own the dwelling**[a] | 4.89E-04 | -85% | 3.11E-04 | -85% |
| **1 more pre-school age child**[a] | 0.001 | -58% | 0.001 | -58% |
| **1 more school age child**[a] | 0.001 | -60% | 0.001 | -60% |
| **Working in different shift**[a] | 0.006 | 96% | 0.004 | 97% |
| **Guidelines**[c] | 0.006 | 91% | 0.004 | 91% |
| **Atlantic** | 0.005 | 55% | 0.003 | 55% |
| **Quebec** | 0.004 | 39% | 0.003 | 40% |
| **Prairie** | 0.004 | 11% | 0.002 | 11% |
| **BC** | 0.003 | 8% | 0.002 | 8% |

a = estimated coefficient significant at 1 percent level
b = estimated coefficient significant at 5 percent level
c = estimated coefficient significant at 10 percent level

## Table 9: Earnings Contributions to Household by Females: Who stay married and those who are divorced

| Married Female | | | |
|---|---|---|---|
| Individuals' contribution to household earnings | Stay married | Divorced next period | Significant difference |
| 93 | 27.59% | 22.33% | NO |
| 94 | 26.70% | 42.36% | YES (t statistics=2.39) |
| 95 | 26.82% | 40.03% | WEAK (t statistics=1.93) |
| 96 | 25.95% | 36.37% | NO |
| 97 | 25.75% | 43.74% | YES (t statistics=2.86) |

## Table 10: Earnings Contributions to Household by Males: Who stay married and those who are divorced

| Married Male | | | |
|---|---|---|---|
| Individuals' contribution to household earnings | Stay married | Divorced next period | Significant difference |
| 93 | 58.45% | 56.72% | NO |
| 94 | 56.30% | 72.47% | YES (t statistics=2.69) |
| 95 | 55.49% | 47.92% | NO |
| 96 | 54.43% | 54.84% | NO |
| 97 | 54.14% | 65.30% | YES (t statistics=2.55) |

**Table 11: Logit Analysis of Marriage/by Cross-Section: Single Female Sample; Dependent variable=1 if married, 0 otherwise**

| | Single Female | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 94 | | 95 | | 96 | | 97 | | 98 | |
| | Coef. | z | Coef. | z | Coef. | z | Coef. | z | Coef. | z |
| **PERSON CHAR** | | | | | | | | | | |
| **Age** | 1.277 | 8.13 | 1.067 | 9.15 | 0.768 | 8.82 | 0.789 | 9.35 | 0.753 | 9.67 |
| **Age^2** | -2.255 | -7.93 | -1.806 | -8.92 | -1.258 | -8.72 | -1.280 | -9.36 | -1.185 | -9.77 |
| **New immigrant** | 1.255 | 1.61 | | | | | | | | |
| **Immigrant** | -0.213 | -0.77 | 0.035 | 0.16 | 0.100 | 0.55 | 0.202 | 1.17 | 0.116 | 0.70 |
| **Education** | -0.064 | -2.05 | -0.038 | -1.46 | -0.020 | -0.90 | -0.058 | -2.77 | -0.032 | -1.68 |
| **Capital gain** | 0.068 | 1.01 | 0.290 | 1.62 | 0.314 | 0.74 | -0.004 | -0.02 | -0.808 | -1.42 |
| **Earnings** | 0.016 | 2.58 | 0.006 | 1.27 | 0.003 | 0.64 | 0.008 | 2.02 | 0.010 | 2.64 |
| **Investment income** | -0.106 | -0.66 | -0.033 | -0.50 | -0.038 | -0.81 | -0.071 | -0.96 | -0.027 | -0.67 |
| **Urban** | -0.675 | -2.68 | -0.887 | -4.42 | -0.549 | -3.18 | -0.555 | -3.39 | -0.558 | -3.59 |
| **PUBLIC GOOD** | | | | | | | | | | |
| **Single Own** | -0.700 | -4.05 | -0.445 | -3.13 | -0.510 | -4.28 | -0.249 | -2.21 | -0.182 | -1.72 |
| **Atlantic** | -0.007 | -0.02 | 0.022 | 0.08 | 0.008 | 0.03 | -0.234 | -1.07 | -0.093 | -0.45 |
| **Quebec** | 0.236 | 1.07 | 0.248 | 1.36 | -0.032 | -0.19 | -0.066 | -0.43 | 0.205 | 1.42 |
| **Prairie** | 0.148 | 0.60 | 0.224 | 1.06 | 0.203 | 1.21 | 0.122 | 0.77 | 0.222 | 1.50 |
| **BC** | -0.190 | -0.72 | 0.186 | 0.88 | 0.270 | 1.54 | 0.023 | 0.14 | 0.270 | 1.73 |
| **constant** | -17.941 | -8.50 | -15.448 | -9.50 | -11.654 | -9.09 | -11.462 | -8.95 | -11.604 | -9.45 |
| **sample size** | 2132 | | 2084 | | 2182 | | 2169 | | 2171 | |
| **Log likelihood** | -526.88 | | -698.16 | | -928.33 | | -1021.87 | | -1120.04 | |

**Table 12: Logit Model of Marriage/by Cross-Section: Single Male Sample; Dependent variable=1 if married, 0 otherwise**

| | Single Male | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 94 | | 95 | | 96 | | 97 | | 98 | |
| | Coef. | z | Coef. | z | Coef. | z | Coef. | z | Coef. | z |
| **PERSON CHAR** | | | | | | | | | | |
| **Age** | 1.047 | 6.44 | 1.010 | 8.03 | 0.706 | 6.85 | 0.680 | 7.47 | 0.565 | 6.88 |
| **Age^2** | -1.792 | -6.33 | -1.627 | -7.79 | -1.142 | -6.85 | -1.094 | -7.56 | -0.897 | -7.13 |
| **New immigrant** | 1.180 | 2.42 | | | | | | | | |
| **Immigrant** | 0.697 | 2.82 | 0.605 | 3.08 | 0.273 | 1.38 | 0.396 | 2.34 | 0.249 | 1.49 |
| **Education** | 0.020 | 0.72 | 0.040 | 1.78 | 0.039 | 1.83 | 0.038 | 2.11 | 0.023 | 1.38 |
| **Capital gain** | -0.009 | -0.62 | 0.112 | 1.50 | -0.040 | -0.30 | 0.080 | 0.64 | 0.105 | 1.66 |
| **Earnings** | 0.017 | 3.28 | 0.007 | 2.05 | 0.018 | 4.95 | 0.016 | 5.43 | 0.017 | 5.86 |
| **Investment income** | 0.002 | 0.03 | -0.020 | -0.40 | 0.051 | 1.87 | 0.044 | 1.56 | 0.048 | 2.06 |
| **Urban** | -0.071 | -0.24 | -0.173 | -0.72 | -0.432 | -2.33 | -0.420 | -2.51 | -0.360 | -2.33 |
| **PUBLIC GOOD** | | | | | | | | | | |
| **Single Own** | -0.476 | -2.57 | -0.479 | -3.08 | -0.376 | -2.68 | -0.337 | -2.74 | -0.187 | -1.60 |
| **Atlantic** | 0.665 | 1.89 | 0.381 | 1.25 | 0.454 | 1.73 | 0.178 | 0.75 | 0.400 | 1.79 |
| **Quebec** | 0.207 | 0.87 | 0.007 | 0.03 | -0.089 | -0.45 | -0.283 | -1.65 | 0.094 | 0.58 |
| **Prairie** | 0.238 | 0.95 | 0.226 | 1.06 | 0.320 | 1.72 | 0.184 | 1.12 | 0.344 | 2.23 |
| **BC** | -0.673 | -1.96 | -0.771 | -2.61 | -0.143 | -0.61 | -0.090 | -0.47 | -0.070 | -0.37 |
| **constant** | -17.841 | -7.75 | -17.601 | -9.38 | -13.075 | -8.31 | -12.317 | -8.72 | -10.635 | -8.07 |
| **sample size** | 2491 | | 2426 | | 2544 | | 2514 | | 2507 | |
| **Log likelihood** | -481.819 | | -622.134 | | -754.174 | | -935.212 | | -1028.655 | |

## Table 11A: Probability of marriage by year and age from Logit Model (table 11): Female sample

Female, non-immigrant, with 13 years of schooling, no capital gain, no investment income, annual earnings 20,000 dollars, living in rural in Ontario, did not own dwelling before marriage

| | AGE=20 | | AGE=30 | | AGE=40 | |
|---|---|---|---|---|---|---|
| 94 | 0.127 | | 0.393 | | 0.031 | |
| 95 | 0.154 | 22% | 0.485 | 23% | 0.116 | 278% |
| 96 | 0.180 | 16% | 0.469 | -3% | 0.224 | 92% |
| 97 | 0.200 | 11% | 0.527 | 12% | 0.277 | 24% |
| 98 | 0.182 | -9% | 0.527 | 0.04% | 0.342 | 24% |

## Table 12A: Probability of marriage by year and age from Logit Model (table 12): Male sample

Male, non-immigrant, with 13 years of schooling, no capital gain, no investment income, annual earnings 20,000 dollars, living in rural in Ontario, did not own dwelling before marriage

| | AGE=20 | | AGE=30 | | AGE=40 | |
|---|---|---|---|---|---|---|
| 94 | 0.030 | | 0.124 | | 0.017 | |
| 95 | 0.037 | 23% | 0.217 | 76% | 0.071 | 310% |
| 96 | 0.065 | 74% | 0.211 | -3% | 0.095 | 34% |
| 97 | 0.094 | 44% | 0.281 | 33% | 0.143 | 50% |
| 98 | 0.093 | -1% | 0.246 | -13% | 0.147 | 3% |

**Table 13: Random Effects Logit Model of Decision to Marry; Dependent variable=1 if married, 0 otherwise**

| | Single female | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | |
| | Coef. | z | Coef. | z | Coef. | z | Coef. | z |
| **PERSON CHAR** | | | | | | | | |
| **Age** | 0.82 | 8.09 | -0.078 | -6.12 | 0.889 | 6.36 | 0.966 | 4.68 |
| **Age^2** | -1.39 | -8.42 | | | -1.516 | -6.73 | -1.644 | -4.98 |
| **New immigrant** | 0.95 | 1.72 | 2.992 | 3.64 | 3.155 | 3.63 | 3.630 | 3.75 |
| **Immigrant** | 0.09 | 0.57 | 0.603 | 2.5 | 0.465 | 1.87 | 0.519 | 1.8 |
| **Education** | -0.04 | -1.96 | 0.021 | 0.79 | -0.039 | -1.33 | -0.048 | -1.37 |
| **Capital gain** | -0.02 | -0.2 | 0.001 | 0.02 | -0.006 | -0.13 | -0.005 | -0.12 |
| **Earnings** | 0.01 | 3.35 | 0.032 | 5.62 | 0.023 | 4.24 | 0.026 | 3.95 |
| **Investment income** | -0.01 | -0.31 | -0.036 | -0.73 | 0.008 | 0.25 | 0.004 | 0.1 |
| **Urban** | -0.48 | -3.4 | -0.966 | -4.55 | -1.019 | -4.68 | -1.094 | -4.27 |
| **PUBLIC GOOD** | | | | | | | | |
| **Single own** | | | -1.868 | 8.71 | -1.757 | -8.54 | -2.612 | -6.51 |
| **Shift** | | | | | 0.137 | 0.84 | | |
| **PUBLIC POLICY** | | | | | | | | |
| **Guidelines** | -0.06 | -0.35 | 0.210 | 1.06 | 0.206 | 1.02 | -0.215 | -0.96 |
| **Trend** | 0.19 | 2.73 | 0.356 | 3.13 | 0.304 | 2.83 | 0.371 | 2.42 |
| **Atlantic** | -0.06 | -0.33 | 0.014 | 0.05 | -0.048 | -0.17 | -0.078 | -0.24 |
| **Quebec** | 0.38 | 2.91 | 0.181 | 0.97 | 0.326 | 1.64 | 0.334 | 1.51 |
| **Prairie** | 0.15 | 1.02 | 0.105 | 0.49 | 0.141 | 0.63 | 0.159 | 0.65 |
| **BC** | 0.20 | 1.34 | 0.147 | 0.67 | 0.095 | 0.42 | 0.069 | 0.28 |
| **Guidelines*single own** | | | | | | | 1.198 | 4.31 |
| **constant** | -31.61 | -4.21 | -34.570 | -3.21 | -42.966 | -3.78 | -50.301 | -2.96 |
| **no. of obs.** | 8542 | | 8542 | | 8542 | | 8542 | |
| **Log likelihood** | -2707.06 | | -2259.398 | | -2191.915 | | -2178.830 | |

**Table 14: Random Effects Logit Model of Decision to Marry; Dependent variable=1 if married, 0 otherwise**

| | Single male | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | |
| | Coef. | z | Coef. | z | Coef. | z | Coef. | z |
| **PERSON CHAR** | | | | | | | | |
| **Age** | 0.58 | 10.50 | -0.040 | -6.01 | 1.013 | 6.14 | 0.443 | 7.23 |
| **Age^2** | -0.98 | -10.55 | | | -1.679 | -6.38 | -0.776 | -7.65 |
| **New immigrant** | 0.99 | 2.79 | 0.017 | 0.03 | 1.775 | 1.63 | -0.057 | -0.1 |
| **Immigrant** | -0.90E-03 | -0.01 | -0.018 | -0.13 | 0.182 | 0.62 | -0.043 | -0.31 |
| **Education** | 0.02 | 1.68 | 0.031 | 2.26 | -0.017 | -0.52 | 0.014 | 1.06 |
| **Capital gain** | -0.89E-03 | -0.07 | -0.004 | -0.28 | 0.029 | 1.27 | -0.001 | -0.06 |
| **Earnings** | 0.02 | 7.89 | 0.022 | 9.95 | 0.039 | 6.67 | 0.018 | 7.95 |
| **Investment income** | -0.01 | -0.30 | -0.050 | -1.6 | -0.108 | -1.72 | -0.029 | -0.8 |
| **Urban** | -0.18 | -1.62 | -0.371 | -2.98 | -0.647 | -2.62 | -0.361 | -2.88 |
| **PUBLIC GOOD** | | | | | | | | |
| **Single own** | | | -1.180 | -13.06 | -2.268 | -8.32 | -1.444 | -9.99 |
| **Shift** | | | | | 0.090 | 0.34 | | |
| **PUBLIC POLICY** | | | | | | | | |
| **Guidelines** | 0.26 | 1.66 | 0.151 | 0.89 | 0.186 | 0.8 | -0.080 | -0.43 |
| **Trend** | -0.03 | -0.62 | 0.027 | 0.45 | 0.559 | 3.9 | 0.003 | 0.05 |
| **Atlantic** | 0.14 | 0.84 | 0.319 | 1.75 | 0.816 | 1.89 | 0.311 | 1.7 |
| **Quebec** | 0.31 | 3.06 | 0.207 | 1.83 | 0.436 | 1.64 | 0.210 | 1.85 |
| **Prairie** | 0.22 | 1.92 | 0.235 | 1.9 | 0.534 | 1.87 | 0.203 | 1.63 |
| **BC** | -0.17 | -1.25 | -0.115 | -0.8 | -0.359 | -1.15 | -0.126 | -0.87 |
| **Guidelines*single own** | | | | | | | 0.553 | 3.14 |
| **constant** | -8.98 | -2.02 | -4.435 | -0.79 | -72.347 | -4.71 | -8.829 | -1.56 |
| **no. of obs.** | 10517 | | 10517 | | 10517 | | 10517 | |
| **Log likelihood** | -2730.67 | | -2229.745 | | -2165.718 | | -2181.244 | |

**Table 15: Logit model of divorce/by Cross-Section: Dependent variable=1 if divorced, 0 otherwise**

| | Matched couple | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 94 | | 95 | | 96 | | 97 | | 98 | |
| | Coef. | z | Coef. | z | Coef. | z | Coef. | z | Coef. | z |
| PERSONAL CHAR | | | | | | | | | | |
| Husband's age | -0.018 | -0.79 | -0.063 | -2.71 | -0.076 | -4.9 | -0.104 | -6.85 | -0.105 | -7.44 |
| Husband's afm | 0.079 | 1.43 | 0.191 | 3.36 | 0.142 | 3.46 | 0.158 | 4.1 | 0.137 | 4.01 |
| Wife's afm | 0.025 | 0.39 | -0.137 | -2.13 | -0.142 | -3.03 | -0.186 | -4.19 | -0.103 | -2.81 |
| Husband's education | 0.052 | 0.83 | 0.056 | 0.94 | -0.002 | -0.05 | -0.022 | -0.59 | 0.030 | 0.94 |
| Wife's education | -0.139 | -1.83 | -0.021 | -0.33 | -0.005 | -0.1 | -0.013 | -0.32 | -0.035 | -1 |
| Husband immigrant or not | 0.707 | 1.26 | -0.058 | -0.11 | -0.894 | -2.17 | -0.754 | -2.03 | -0.784 | -2.13 |
| Wife immigrant or not | -0.092 | -0.15 | 1.141 | 2.07 | 0.329 | 0.78 | 0.924 | 2.46 | 0.610 | 1.64 |
| Husband's earning | -0.003 | -0.39 | -0.004 | -0.63 | 0.004 | 1.03 | 0.000 | -0.11 | -0.001 | -0.25 |
| Wife earning | 0.002 | 0.15 | -0.017 | -1.4 | 0.005 | 0.87 | 0.015 | 2.7 | 0.016 | 3.66 |
| Urban | 0.799 | 1.17 | 0.902 | 1.64 | 0.660 | 1.93 | 0.098 | 0.34 | -0.132 | -0.51 |
| PUBLIC GOODS | | | | | | | | | | |
| Dwelling ownership | -2.398 | -5.56 | -1.988 | -5.1 | -2.098 | -8.26 | -1.982 | -8.09 | -2.087 | -9.39 |
| Pre-school children | -1.279 | -1.76 | -5.221 | -3.01 | -1.848 | -1.35 | -3.096 | -3.31 | -3.098 | -4.39 |
| School age children | -2.605 | -4.06 | -2.828 | -5.35 | -1.623 | -5.22 | -1.453 | -5.75 | -1.813 | -6.23 |
| pre-school^2 | 0.385 | 1.3 | 1.333 | 1.8 | -0.262 | -0.25 | 0.452 | 0.82 | | |
| school age^2 | 0.463 | 3.65 | 0.540 | 4.21 | 0.233 | 2.44 | 0.158 | 2.25 | 0.221 | 2.13 |
| Shift no match | -0.128 | -0.28 | 1.887 | 4.89 | 0.411 | 1.64 | 0.425 | 1.85 | 0.458 | 2.1 |
| Atlantic | 1.117 | 1.61 | 0.931 | 1.57 | 0.282 | 0.73 | 0.429 | 1.19 | 0.315 | 0.95 |
| Québec | 0.962 | 1.94 | 0.356 | 0.79 | -0.174 | -0.53 | 0.159 | 0.49 | 0.369 | 1.31 |
| Prairie | 0.035 | 0.05 | 0.343 | 0.65 | 0.349 | 1.07 | 0.289 | 0.91 | -0.084 | -0.27 |
| BC | 1.510 | 2.76 | 0.368 | 0.65 | -0.032 | -0.08 | 0.511 | 1.55 | 0.318 | 1 |
| constant | -4.375 | -2.55 | -2.964 | -1.72 | 1.063 | 0.89 | 3.548 | 3.06 | 2.594 | 2.52 |
| **sample size** | 3429 | | 3374 | | 3440 | | 3431 | | 3229 | |
| **Log likelihood** | -145.417 | | -153.781 | | -319.304 | | -361.498 | | -411.096 | |

**Table 15A: Probability of divorce by year, age of husband, ages at first marriage of husband and wife from Logit Model (table 15)**

Matched couple, both have 13 years of schooling, both are non-immigrant, husband's earnings are 40,000 dollars annually, wife's earnings are 20,000 dollars annually, the couple does not own a dwelling, they have one pre-school age child and one school-age child; they work a same shift; and they live in urban Ontario.

| | HUSBAND AGE=30 | | | | HUSBAND AGE=40 | | | |
|---|---|---|---|---|---|---|---|---|
| | AFM=25 FAFM=23 | | AFM=25 FAFM=20 | | AFM=25 FAFM=23 | | AFM=25 FAFM=20 | |
| 94 | 0.003 | | 0.003 | | 0.002 | | 0.002 | |
| 95 | 1.92E-04 | -93% | 2.89E-04 | -89% | 1.03E-04 | -96% | 1.55E-04 | -93% |
| 96 | 0.026 | 13401% | 0.039 | 13440% | 0.012 | 11837% | 0.019 | 11955% |
| 97 | 0.019 | -25% | 0.033 | -15% | 0.007 | -43% | 0.012 | -36% |
| 98 | 0.016 | -16% | 0.022 | -34% | 0.006 | -17% | 0.008 | -35% |

**Table 16: Random Effects Panel Logit Model, Decision to divorce (y=1 if divorced, 0 otherwise)**

| | 1 | | 2 | | 3 | | 4 | |
|---|---|---|---|---|---|---|---|---|
| | Coef. | z | Coef. | z | Coef. | z | Coef. | z |
| PERSONAL CHAR | | | | | | | | |
| Husband's age | -0.046 | -3.67 | -0.047 | -3.72 | -0.045 | -3.61 | -0.044 | -3.53 |
| Husband's afm | 0.131 | 4.06 | 0.132 | 4.11 | 0.129 | 4.02 | 0.129 | 4.01 |
| Wife's afm | -0.115 | -3.14 | -0.116 | -3.19 | -0.114 | -3.11 | -0.116 | -3.18 |
| Husband's education | 0.031 | 1 | 0.031 | 1.01 | 0.030 | 0.98 | 0.031 | 1.03 |
| Wife's education | -0.049 | -1.34 | -0.050 | -1.37 | -0.049 | -1.34 | -0.049 | -1.34 |
| Husband immigrant or not | -0.604 | -1.97 | -0.620 | -2.02 | -0.594 | -1.94 | -0.619 | -2.01 |
| Wife immigrant or not | 0.399 | 1.25 | 0.411 | 1.29 | 0.395 | 1.24 | 0.400 | 1.25 |
| Husband's earning | 0.000 | 0.07 | 0.000 | 0.1 | 0.000 | 0.05 | 0.000 | 0.09 |
| Wife earning | 0.012 | 2.56 | 0.012 | 2.56 | 0.012 | 2.53 | 0.012 | 2.54 |
| Urban | 0.427 | 1.58 | 0.424 | 1.57 | 0.441 | 1.64 | 0.432 | 1.6 |
| PUBLIC GOODS | | | | | | | | |
| Dwelling ownership | -2.099 | -6.64 | -1.890 | -9.11 | -2.104 | -6.63 | -1.903 | -9.21 |
| Pre-school children | -1.424 | -2.52 | -1.426 | -2.52 | -1.665 | -3.36 | -1.197 | -5.54 |
| School age children | -1.609 | -6.74 | -1.613 | -6.77 | -1.610 | -6.75 | -1.091 | -7.3 |
| pre-school^2 | 0.266 | 1.03 | 0.266 | 1.03 | 0.270 | 1.15 | | |
| school age^2 | 0.231 | 3.54 | 0.230 | 3.55 | 0.232 | 3.56 | | |
| Shift no match | 0.693 | 3.62 | 0.685 | 3.58 | 0.687 | 3.59 | 0.679 | 3.56 |
| PUBLIC POLICY | | | | | | | | |
| Guidelines | 0.577 | 1.38 | 0.750 | 2.03 | 0.470 | 1.15 | 0.644 | 1.79 |
| Trend | -0.117 | -0.93 | -0.118 | -0.93 | -0.113 | -0.9 | -0.116 | -0.92 |
| Atlantic | 0.437 | 1.38 | 0.436 | 1.37 | 0.440 | 1.38 | 0.423 | 1.33 |
| Québec | 0.329 | 1.35 | 0.335 | 1.38 | 0.327 | 1.34 | 0.315 | 1.3 |
| Prairie | 0.105 | 0.36 | 0.100 | 0.34 | 0.108 | 0.37 | 0.096 | 0.33 |
| BC | 0.077 | 0.24 | 0.068 | 0.21 | 0.082 | 0.25 | 0.046 | 0.14 |
| Guideline*pre-school children | -0.487 | -1.26 | -0.495 | -1.28 | | | | |
| Guideline*dwelling ownership | 0.336 | 0.88 | | | 0.347 | 0.91 | | |
| constant | 8.885 | 0.74 | 8.850 | 0.74 | 8.563 | 0.72 | 8.677 | 0.73 |
| Sample Size | 16779 | | 16779 | | 16779 | | 16779 | |
| Log likelihood | -637.678 | | -638.073 | | -638.510 | | -642.442 | |

**Table 17: Probability Impact on Reference individual: Single female, non-immigrant, with 13 years of schooling, no capital gain, no investment income, annual earnings 20,000 dollars, and living in rural Ontario.[3]**

| | AGE=30 | | | | AGE=40 | | | |
|---|---|---|---|---|---|---|---|---|
| | year=94 | | year=98 | | year=94 | | year=98 | |
| **probability of marriage** | 0.121 | | 0.228 | | 0.029 | | 0.060 | |
| **New immigrant[c]** | 0.281 | 132% | 0.455 | 100% | 0.078 | 169% | 0.153 | 155% |
| **Immigrant** | 0.131 | 8% | 0.244 | 7% | 0.032 | 9% | 0.065 | 9% |
| **+4 yrs education[b]** | 0.105 | -13% | 0.201 | -12% | 0.025 | -14% | 0.052 | -14% |
| **+50 capital gain** | 0.121 | 0% | 0.228 | 0% | 0.029 | 0% | 0.060 | 0% |
| **+10K earning[a]** | 0.132 | 9% | 0.246 | 8% | 0.032 | 10% | 0.066 | 10% |
| **+50 investment income** | 0.121 | 0% | 0.228 | 0% | 0.029 | 0% | 0.060 | 0% |
| **Urban[a]** | 0.079 | -35% | 0.154 | -32% | 0.018 | -37% | 0.038 | -37% |
| **Guidelines** | 0.115 | -5% | 0.218 | -5% | 0.027 | -6% | 0.057 | -5% |
| **Atlantic** | 0.115 | -5% | 0.218 | -5% | 0.027 | -6% | 0.057 | -5% |
| **Québec[a]** | 0.168 | 38% | 0.302 | 32% | 0.042 | 44% | 0.085 | 42% |
| **Prairie** | 0.138 | 14% | 0.255 | 12% | 0.034 | 16% | 0.069 | 15% |
| **BC** | 0.144 | 19% | 0.265 | 16% | 0.035 | 21% | 0.072 | 21% |

a = estimated coefficient significant at 1 percent level
b = estimated coefficient significant at 5 percent level
c = estimated coefficient significant at 10 percent level

[3] Specification No. 1 of table 13.

**Table 18: Probability Impact on Reference individual: Single male, non-immigrant, with 13 years of schooling, no capital gain, no investment income, annual earnings 20,000 dollars, and living in rural Ontario.[4]**

| | AGE=30 | | | | AGE=40 | | | |
|---|---|---|---|---|---|---|---|---|
| | year=94 | | year=98 | | year=94 | | year=98 | |
| **probability of marriage** | 0.072 | | 0.064 | | 0.026 | | 0.023 | |
| **New immigrant[a]** | 0.172 | 140% | 0.156 | 143% | 0.067 | 158% | 0.060 | 159% |
| **Immigrant** | 0.072 | 0% | 0.064 | 0% | 0.026 | 0% | 0.023 | 0% |
| **+4 yrs education** | 0.077 | 8% | 0.069 | 8% | 0.028 | 8% | 0.025 | 8% |
| **+50 capital gain** | 0.072 | 0% | 0.064 | 0% | 0.026 | 0% | 0.023 | 0% |
| **+10K earning[a]** | 0.086 | 20% | 0.077 | 20% | 0.032 | 21% | 0.028 | 22% |
| **+50 investment income** | 0.072 | 0% | 0.064 | 0% | 0.026 | 0% | 0.023 | 0% |
| **Urban[c]** | 0.061 | -15% | 0.054 | -16% | 0.022 | -16% | 0.019 | -16% |
| **Guidelines[c]** | 0.091 | 27% | 0.082 | 27% | 0.034 | 29% | 0.030 | 29% |
| **Atlantic** | 0.082 | 14% | 0.073 | 14% | 0.030 | 15% | 0.027 | 15% |
| **Québec[a]** | 0.095 | 33% | 0.085 | 33% | 0.035 | 35% | 0.031 | 35% |
| **Prairie[c]** | 0.088 | 22% | 0.079 | 23% | 0.032 | 24% | 0.029 | 24% |
| **BC** | 0.061 | -15% | 0.055 | -15% | 0.022 | -15% | 0.020 | -15% |

a = estimated coefficient significant at 1 percent level
b = estimated coefficient significant at 5 percent level
c = estimated coefficient significant at 10 percent level

[4] Specification No. 1 of table 14.

## APPENDIX A Table A1

| LITERATURE | Purpose | Data | Sample | Dependent Variable | Independent Variables | Methodology | Major Findings |
|---|---|---|---|---|---|---|---|
| **Alm James and Whittington L.A. (1997)** | The effect of income tax on the timing of marriage decision. | The PSID(1967-1989) | The sample is limited to individuals who married in either the first or the fourth quarters of the year. | Whether or not the couple delays marriage from the fourth quarter to the first quarter | Change in marginal tax rate; marital income; gender; youth and elderly dummy; gender; pregnant; birth. | logit | The timing of marriage is in part based on the tax consequences. |
| **Alm James and Whittington L.A. (1999)** | The impact of income tax on decision to marry | The 1992 PSID | The sample is composed of 1605 individuals. | The probability of marriage | Marriage penalty; marginal tax rate difference; own income; married income; spouse income; age; rural; race; marriage; | A discrete-time logit approximation to a continuous hazard. | The value of the marriage tax/subsidy affects the marriage decision of females. They also find some evidence that the change in the marginal tax rate generated by marriage has a significant and negative impact on the probability of marriage. |
| **Becker, Landes and Michael (1977)** | The causes of first marital instability(SEO);Search Costs and prob of divorce (Terman Survey) | 1967 Survey of Economic Opportunity (SEO) data and Terman Survey | white men and white women aged 35-55 | 1.The probability of divorce in the *ith* 5-year interval of marriage conditional upon being married at the beginning of that interval;2.The probability of remarriage by the nth year after the termination of first marriage | 1. Man: Age at marriage, Age at marriage^2,schooling67,age67, earning66,earning66^2;2. Woman: AM, AM^2,Schooling,Age, Premarital pregnant, number of children under 6 and between 6-17;3. Woman: AM, AM^2,Schooling,Age, Premarital pregnant, number of children under 6 and between 6-17;4. Man: Age at divorce, AD^2,Schooling,age widow, earning, duration of first marriage;5. Woman: AD,AD^2,schooling age, number of children from the first marriage, No children dummy from the first marriage, duration of first marriage, widow; | | 1. Persons who marry relatively young are far more likely to dissolve their marriages than are those who marry at 'normal' ages;2. Education is not stable in sign and insignificant;3. An increase in the expected earnings of men reduces the prob of dissolution on first marriage, raises the speed the prob of remarriage. Women are opposite;4. Unanticipated events, whether favorable or unfavorable, tend to destabilize marriage;5. AD has negative effect on the prob of remarriage, an effect which is stronger for female;6. Divorced are more likely to remarry than widowed;7. An increase of number of children, especially younger children, from a first marriage, reduces the prob of dissolution and the speed and prob of remarriage for mothers with custody;8. An increase in the prob of dissolution reduces the demand for children and for other marital-specific capital;9. A person who married outside of his or her religion is much more likely to dissolve the marriage;10. The prob of dissolution is much higher on second marriage. |

**APPENDIX A** Table A1 - (continued)

| LITERATURE | Purpose | Data | Sample | Dependent Variable | Independent Variables | Methodology | Major Findings |
|---|---|---|---|---|---|---|---|
| **Furstenberg F. F., Hoffman S. D. and Shrestha L. (1995)** | 1. Whether marital disruption affects the flow of monetary and time transfers between parents and their children in later life. Whether it does so differently for mothers than for fathers;<br>2. It is also explored how the timing of divorce is implicated in the pattern of exchange;<br>3. Whether the provision of child support moderates the impact of divorce on pattern of exchange in later life; | 1988 wave of PSID | A sample is composed of adult children whose parents are also part of the PSID sample. The matched sample includes a total of 3,295 adult children with at least one living sample parent. | Time and money transfers between adult children and their parents. | Parents: divorce dummy, divorce*mother, currently married, has health problems, income. Children: daughter, white, married, has children, income age, age^2. | Multivariate logit estimates of the prob of time and money transfer between adult children and their parents. | 1. Divorce has a negative effect on downward transfers from mothers and a smaller positive effect on upward transfers with mothers; for fathers, divorce has an enormous effect on transfers in both directions;<br>2. When biological parents postpone divorce until the children are young adults, ties between men and their children are unaffected;<br>3. Their findings do not support the idea that potential benefits of greater child support enforcement for strengthening family relationship. |
| **Hoffman S. D. and Duncan G. J. (1995)** | The AFDC's (Aid to Families with Dependent Children) effect on marital disruption | The PSID | The sample is from 1968-1987 waves and includes 1,098 first marriages. | The probability of divorce | Number of children; husband's income and square term; wife's education; wife's age; race; wife's wage rate; AFDC; region; race; wife's age at first marriage; whether child<age 6; duration. | The hazard model and a competing-risks model in which they distinguish between divorces that do and do not involve subsequent receipt of welfare income (Nested logit model) | AFDC benefits slightly increase marital dissolution's rates; while husband's earnings and wife's wage reduce the probability of divorce. |
| **Waite L. J. and Lillard L. A. (1991)** | To study the effect of children on marital stability | The PSID | The sample is from the first 18 waves, 1968-85, of the PSID. | The hazard of divorce | Premarital births; race; age of head when marry; age of wife when marry; education; year married; number of children; income. | The proportional hazards model | 1. The existence of children decreases the probability of divorce;<br>2. Younger children has stronger effect than older children;<br>3. Under some circumstances, children could become a source of marital tension as they get older. |

**APPENDIX A** Table A1 - (continued)

| LITERATURE | Purpose | Data | Sample | Dependent Variable | Independent Variables | Methodology | Major Findings |
|---|---|---|---|---|---|---|---|
| **Lillard L.A. and Waite L. J. (1993)** | To study the simultaneous relationships between marital dissolution and marital fertility. | The PSID. | The sample is composed of 2,376 female respondents. | Marital conception and the hazard of disruption | Children born in current marriage; stepchildren; previous marriage; religion dummy; wife's education; race; state divorce legislation; aggregate divorce rate; number of siblings; marriage duration; annual per-student state expenditures on education. | Simultaneous hazard functions | 1. The probability of divorce has strong negative effects on the fertility decision;<br>2. The first child decreases strongly the probability of divorce;<br>3. Age decreases the probability of divorce. |
| **Loughran David S. (2002)** | The effect of male wage inequality on marriage propensity of female | The 1970, 1980, and 1990 public-use microsample of the US Decennial Census (PUMS) | The potential partner of female sample is matched by three dimensions: geographical location, education, and race; The ages of women are limited to 22-30 | Probability of ever married. | 1. Use the difference in log hourly male wages at the 90th and 50th percentiles and the 50th and 10th percentiles as the measure of male wage inequalities;<br>2. Sex ratio;<br>3. age, year, geographical information. | Weighed least squares | There is a negative correlation between male wage inequality and female propensity to marry. |
| **Kidd M. P. (1995)** | Examine the impact of no-fault divorce legislation on divorce | The Australian Bureau of Statistics Family Survey (1982) | To compare with Becker's study, the sample was limited to females age less than 55. The sample size is 8608, among which 1221 divorced. | Probability of divorce | age at first marriage; age at first marriage square; schooling; legislation; country of birth; employment status; number of years since arriving in Australia; age; potential length of marriage; a dummy indicating whether or not the birth of first child occurred within the first twelve months of marriage | Cox proportional hazard method | 1. Age at first marriage has a negative effect and its square term has a positive effect;<br>2. The presence of early first child birth significantly increases the probability of divorce;<br>3. Education increases the probability of divorce;<br>4. The no-fault legislation has a positive effect on divorce decision;<br>5. Age minus age at first marriage has a negative effect on divorce decision. |

**APPENDIX A** Table A1 - (continued)

| LITERATURE | Purpose | Data | Sample | Dependent Variable | Independent Variables | Methodology | Major Findings |
|---|---|---|---|---|---|---|---|
| **Koo H. P. and Janowitz B. K. (1983)** | Interrelationships between fertility and marital dissolution | The 1970 National Fertility Study. | The sample was composed of white women who first married in 1947-1956 and in 1957-1966. | The probability of marital dissolution and the fertility during the interval. | number of children; whether parents were divorced; childhood residence; age at first marriage; education; premarital conception or not; differences in age and education between spouses and the squared terms; religion; whether or not husband married before; employment status before marriage. | The simultaneous logit | The relationship between fertility variables - number of children, presence of a very young child, or the very recent childbearing - is not always clear. In only a few marital duration intervals there exists significant relationship between separation and recent childbearing. |
| **Nakosteen R. A. and Zimmer M. A. (1997)** | It is studying whether or not married men seem to earn more just because they are more attractive for marriage. | PSID (Panel Study of Income Dynamics) | 2,350 males from 1979 wave of the PSID who were employed and out of school and were tracked through the 1982 and 1984 wave. | Earnings, probabilities of marriage and divorce. | 1. Earnings: Years Education; Years experience; Experience squared; Race; Military veteran; Physical disability.<br>2. Marriage: Age; parents' education; education dummies; race; a fitted value of earnings from the prior period; standardized residual from his prior earnings.<br>3. Age; number of children; race; religion; fitted earnings; standardized residual. | OLS and probit | Single men with higher earnings are more likely to become married and married men with higher earnings are less likely to become divorced. |
| **Nixon Lucia A. (1997)** | Examine the theoretical effects of CSE (Child Support Enforcement) on divorce. The effect of CSE on divorce is identified by cross-state variation in the CSE policy climate. | Microdata from Current Population Survey (1988 and 1990) | All child-support - eligible adult women who are divorced or currently married. | The probability of becoming divorced in the five-year window prior to the survey year, given marriage has occurred by the survey year and there has been no prior divorce. | 1. *Collection rate* is the percent of CSE cases in which a collection is made;<br>2. *accounts receivable* is the percentage of child support dollars owned that is collected accounts receivable is the percentage of child support dollars owned that is collected;<br>3. *Average collections* is dollars collected per CSE case, divided by state median household income;<br>4. *Child support enforcement composite* is a measure of CSE effectiveness;<br>5.*GPA* is a grade point average assigned to each states;<br>6. State characteristics;<br>7. individual characteristics: age,age^2, education | Probit | Stronger CSE has a negative effect on divorce |

**APPENDIX A** Table A1 - (continued)

| LITERATURE | Purpose | Data | Sample | Dependent Variable | Independent Variables | Methodology | Major Findings |
|---|---|---|---|---|---|---|---|
| **Peters H. Elizabeth (1986)** | The paper is studying impact of unilateral and mutual divorce laws. | Current Population Survey March/April 1979 | 1,221 women who became divorced between 1975 and 1978, and who indicated that they had lived in the same state in 1975 as in 1979 are combined with the sample of currently married, never-divorced women who lived in the same state in 1979 as in 1975. | 1. Probability of divorce and remarriage;<br>2. OLS regressions of amount of divorce settlement received (Alimony; Child Support; Property settlement);.<br>3. The effect of unilateral divorce laws on the labor force participation and fertility behaviour of married women | Age(in the remarriage it is age at divorce); education; race; number of kids under 18; kids squared; geographical information; whether or not in labor force in 1978; time since divorce; religion; divorce law; state divorce rate in 1970. | Logit | 1. Divorce is less likely if a woman is older, more educated, with more kids, not living in urban.<br>2. The unilateral divorce rule is insignificant;<br>3. Even though the divorce rate does not differ between unilateral and mutual divorce law the compensation schemes do differ. Especially the amounts of alimony and child support received are significantly lower in unilateral states;<br>4. Unilateral divorce increases the labour participation of married women but not significant on fertility decision. |
| **Peters H. Elizabeth (1993)** | The relation between the financial opportunity cost of divorce and the decision to divorce. | National longitudinal Survey of Work Experience of Young Women (NLS) | The sample contains 1203 continuously married women and 123 divorced women. | The probability of divorce, present values of the future income streams from the choice of divorce, d, and staying married, m. | Race, education, age, location, current earnings and income. | Probit with sample selection bias | The financial consequences affect the decisions to divorce. However, short-term consequences matter more. |
| **Peters H. E., Argys L. M., Maccoby E. E. and Mnookin R. H. (1993)** | It is looking at the determinants of noncompliance with child support awards. | The Stanford Child Custody Project ( a longitudinal data set) | A sample of approximately 1,000 families for whom divorce petitions had been filed in California in either San Mateo or Santa Clara county between September 1984 and March 1985. The children within families are at 16 or younger at the first survey. | 1. Any post-divorce modifications of the financial terms of the divorce settlement by time 3.<br>2. Child Support compliance at time 3. | Parents' involvement with their children before and after separation; parents' age earnings, education and labour participation; measures of changes in circumstance; the degree of parental conflict over initial divorce settlement. | Bivariate and Multivariate logit. Bivariate and multivariate Tobit. | 1. Unemployed fathers are more likely to have a modification.<br>2. Fathers who have no regular contact with their children are less likely to negotiate a modification.<br>3. A change in the custodial arrangement also significantly affect the formal compliance rate. |

**APPENDIX A** Table A1 - (continued)

| LITERATURE | Purpose | Data | Sample | Dependent Variable | Independent Variables | Method ology | Major Findings |
|---|---|---|---|---|---|---|---|
| **Smock Pamela J.(1990)** | The effect of education on remarriage patterns of black and white women. | The National Survey of Families and Household s | The sample is composed of 1700 women, of whom about 350 are black. | The probability of remarriage | Age at first marriage. Age at separation; separation cohort; education attainment and fertility status | Proportional hazard model. | Education has a positive effect on remarriage decision of black women while it has little effect on white women. |
| **Weiss Yoram and Robert J. Willis (1997)** | It is to look at the determinants of divorce. | NLS (the National Longitudinal Study of the High School Class of 1972. | 7,588 white respondents (3,643 males and 3,945 females) who had a first marriage by 1986. | probability of divorce | Unexpected changes in husband's or wife's earning capacity; costs of divorce; duration of marriage; schooling; demographic and match variables. | probit | 1. An unexpected increase in the husband's predicted earning capacity reduces the probability of divorce while an unexpected increase in the wife's predicted earning capacity increases the probability of divorce. |
| **Zelder Martin (1993)** | The effect of children on the occurrence and efficiency of divorce when the legal regime switches from fault to no-fault. | the PSID | The period 1968-1981, wave 14 of the PSID. | Probability of divorce | Total child expenditures; no-fault dummy; husband's income; wife's income; religion; migration dummy; race; number of previous divorces; age at first marriage; marriage duration; education of spouses; divorce law duration; US divorce rate; assets; the interactive term between no-fault dummy and relative child-wealth. | probit | More divorces occur in regime of no-fault divorce. The reason is that the public-goods aspect of children within marriage can make a large fraction of each spouse's gains to marriage nontransferable. |

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