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## Gender Division of Labor and Alimony

Waka Cheung\* and Yew-Kwang Ng†

### Abstract

According to the principle of comparative advantage, the gender division of labor is utility enhancing during marriage. However, in the long term it decreases the earning power of the party who specializes in housework. Once the marriage is dissolved she/he will be the losing party and hence should be compensated by the other party, who specializes in paid work which usually involves higher degree in the accumulation of human capital. As an effective means of compensation, it is shown formally that alimony may promote the gender division of labor and improve Pareto efficiency. The rule of remarriage termination of alimony is doubly inefficient by reducing gender division of labor and by discouraging efficient remarriages.

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\* Waka Cheung

† Department of Economics, Monash University Clayton Campus email: [kwang.ng@monash.edu](mailto:kwang.ng@monash.edu)

## 1. Introduction

This paper explores the effect of alimony on the gender division of labor, where alimony (or called as spousal support or spousal maintenance) is the amount of money one spouse pays to the other, by court order, for support and maintenance, after divorce.

According to the literature of gender division of labor, there are mainly three theoretical perspectives of the gender division of labor. The first is the gender-role ideology (e.g. Bird et al 1984; Kamo 1988; Ross 1987; Seccombe 1986). It suggests that men and women eternalize traditional sex roles to varying degrees depending upon their early life experiences. The resulting gender identities of people correlate with their sex-role expectations for themselves and others and become evident in their own behavior with respect to gender division of labor. The proposition is that the more deeply one or both partners has internalized the traditional sex role, the more likely the wife will be solely responsible for family work

The second perspective focuses on the availability of time (e.g. Coverman 1985; England and Farkas 1986; Hiller 1984). It considers that differences in spouses' participation in family work depend upon the ease with which either partner can do it, and ease is determined by time and skill. If the amount of time available were a powerful predictor, one would expect a more equitable division of family work when wives are employed.

The third perspective focuses on relative resources (e.g. Blood and Wolf 1960; Brines 1994). It predicts that the partner with greater resources exhibits more power in the relationship. Power has been typically conceptualized as dominance in decision making, and resources have most often been considered to be education, occupation, and income. In later years, the same hypothesis has also been used to explain division of family work, in which it is posited that the partner bringing the relatively greater share of these resources to the marriage can minimize his/her participation in household and child care duties.

Besides the factors mentioned above, there are some other factors of the gender division of labor. For example, according to South and Spitze's (1994) empirical evidences, in all situations, women spend more time than men doing housework, and the gender gap is widest among married persons. Moreover, the time women spend in doing housework is higher among cohabitants than among the never-married, is

highest in marriage, and is lower among divorcees and widows. The empirical results show that marriage is a positive factor contributing to the gender division of labor.

Why do married couples engage in division of labor? Our basic idea is that, on average, man and women are endowed with different comparative advantages, usually the male has comparative advantage in market or social production while the female in home production (interpreted to include child bearing and care). Fafchamps and Quisumbing (2003) find that intrahousehold gender division of labor is influenced by comparative advantage based on human capital and by long-lasting returns to learning-by-doing. Bardasi and Taylor (2008) find a statistically significant marital wage premium that can be attributed to productivity differences largely resulting from intra-household specialization or gender division of labour. Hersch and Stratton (1994) show that, even in the situation where both spouses are employed full time, the husband's share of housework time is only 29%. In addition, the husband's share of housework time decreases significantly with his share of labor income and his share of labor-market hours. It implies that there is some gender division of labor according to comparative advantage, though not quite the complete division of labor in the traditional family.

Although the division of labor enlarges the pie, it will reduce the female's threat point (the maximum utility in autarky) due to a lower accumulation of human capital (through learning by doing) in home compared to social production. This will put her in a disadvantage in the allocation of the family's output. This is the hold-up problem caused by the gender division of labor. For the long-term interest, the more bargaining power she will lose, the lower degree of division of labor she is willing to engage in. Since alimony can be prescribed to keep the couple's bargaining power after the division of labor, the hold-up problem is eliminated or at least reduced and hence the couple is willing to intensify the division of labor during cooperation. Thus, alimony has a useful function not only in achieving fairness in compensating the party who loses from engaging in home production with its lower accumulation of human capital but also in promoting a more efficient level of gender division of labor. The use of fore-gifts may also help but is shown to be inferior to alimony.

There are some key points in this model. The first is how a family makes a decision about the production and output allocation? Some scholars (e.g. Becker 1991; Hadfield 1999) assume that the family maximizes a joint welfare function in allocation the family's production. But these models ignore the friction within the

family. On the other hand, some scholars (e.g. Bergstrom 1996; Lundberg and Pollak 1993 1994; and Weiss and Willis 1985) assume that the couple uses Nash bargaining to arrange the allocation of time and goods. Recently some dynamic Nash bargaining models (e.g. Baker and Jacobson 2007; Konrad and Lommerud 2000; and Vagstad 2001) have been developed to explore the incomplete specialization in a family.

In the vein of these dynamic models, we construct a two-period Nash bargaining model. Compared with these models, we contribute in several ways. First, previous models study the degree of specialization in education, which usually occurs before marriage; our model studies the degree of the division of labor during marriage or cohabitation.

Next, there are “public goods” models of marriage (e.g. Lundberg and Pollak 1993 1994; Konrad and Lommerud 1995), in which marital surplus arises through the provision of public goods within marriage, while in the present model the surplus comes from the division of labor according to the endowed comparative advantage. We explain why the couple may choose a lower degree of division of labor against comparative advantage. According to Becker (1985, p37-38), there are differences between home production and social production in the contribution from specialized human capital to productivity. The tasks in home production are petty and scattered, thus the investment in human capital is dispersed to different tasks. While in social production, the mode of specialized production is widely used, thus the contribution of human capital to productivity is larger than that in home production. In this two-period model, the productivity in period 2 is positively correlated with the producer’s experience (learning by doing) in the industry, indexed by the time input in period 1. Since the difference in the contribution from experience to productivity, putting more effort on home production will benefit less than putting more effort on social production. It means that If the couple chooses (complete) specialization in period 1, the female will lose her bargaining power and hence the share of allocation in period 2, though she will get more from a bigger pie in period 1. For the long-term interest the female may prefer a lower degree of division of labor in period 1.

Third, alimony is embedded into the model for studying its effect on the division of labor. We show how the alimony increases the degree of the gender division of labor? We construct two models to study the division of labor between unmarried couples and married couples respectively. In the first model the loss of the unmarried female is compensated by fore-gift, which is paid before the division of labor. While

in the second model the loss can be compensated by alimony, which is paid once the marriage is dissolved. Compared with alimony, fore-gift has lower efficiency in compensation, which shows in two aspects. First, before the division of labor, the lost is uncertain or even unknown, thus fore-gift can compensate the expected loss at best. Second, using the income today to compensate the loss tomorrow, it will inevitably distort the distribution of consumption in their lifetime, especially when the total loss is large. With higher efficiency in compensation, alimony may improve the degree of division of labor, and thus improve the Pareto efficiency of the family, making both sides better off. We ignore other complicating factors such as the in-family choice of specialization between investment for future and financing for current consumption of credit-constrained migrants (Cobb-Clark & Crossley 2004).

This paper is organized as follows. Two models are presented in Section 2, which show the gender division of labor between unmarried couples and married couples respectively. Section 3 shows the effect of alimony on the gender division of labor. This paper concludes in section 4, and all the proofs of propositions are contained in Section 5.

## 2. Model

Assume that a family consists of two individuals, a male (M) and a female (F). There are two final goods, the social product (X) and the home product (Y). There are two periods, period 1 and period 2. In each period, an individual is endowed with one unit of time. For simplicity, we ignore the consumption of leisure and assume that all endowed time is used as inputs for production.

There are two strategies in each period. The first is the strategy with low degree of division of labor (L), where each individual will use half unit of time in producing X and the other half unit of time in producing Y. The other is the strategy with high degree of division of labor (H), where an individual will use one unit of time in producing X, while the other will use one unit of time in producing Y.

Assume that the male's production function of x is:

$$x = \begin{cases} Al_{x1}, & \text{in period 1} \\ A(1 + \alpha l_{x1})l_{x2}, & \text{in period 2} \end{cases} \quad (2.1)$$

where  $A (>1)$  is the productivity,  $\alpha (>0)$  is the efficiency coefficient which represents the efficiency experience contributes to the productivity,  $l_{x1}$  and  $l_{x2}$  are the time input in the production of X in period 1 and period 2 respectively.

Besides, his production function of y is:

$$y = \begin{cases} l_{y1}, & \text{in period 1} \\ l_{y2}, & \text{in period 2} \end{cases} \quad (2.2)$$

where  $l_{y1}$  and  $l_{y2}$  are the time input in the production of Y in period 1 and period 2 respectively.

For the female, on the other hand, the production function of x is:

$$x = \begin{cases} l_{x1}, & \text{in period 1} \\ (1 + \alpha l_{x1})l_{x2}, & \text{in period 2} \end{cases} \quad (2.3)$$

And her production function of y is:

$$y = \begin{cases} Al_{y1}, & \text{in period 1} \\ Al_{y2}, & \text{in period 2} \end{cases} \quad (2.4)$$

The production functions imply two assumptions. First, basing on Becker's (1985, p37-38) idea (mentioned in the introduction above), we assume that the productivity in social production increases more from experience than the productivity in home production does ( $\alpha > 0$ ). Here, for simplicity, we simply assume that the productivity in home production does not increase from experience.

Second, we assume that the male and the female have different comparative advantages. On average, the male has comparative advantage in social production while the female in the home production. In this model coefficient  $A$  represents the degree of comparative advantage between the male and the female.

Assume that the male and the female have the same utility function:

$$u = \sqrt{x_1 y_1} + \delta \sqrt{K x_2 y_2} \quad (2.5)$$

where  $x_t$  and  $y_t$  are respectively the amount of goods X and Y consumed in period  $t$ , and  $\delta$  ( $0 < \delta < 1$ ) is the discount rate. The use of the same utility function shows that our results come from the issues analyzed rather than the difference in preference.

Because of the comparative advantage, both the male and the female will benefit from the division of labor. As the price, they need to pay the coordination cost. In (2.5), index  $K$  ( $0 < K \leq 1$ ) denotes the coordination efficiency which presents the quality of match between the two partners. For simplicity, there are only two levels in coordination efficiency. When  $K=1$  (without any coordination cost), people will

choose division of labor given comparative advantage. Thus it is reasonable to assume the situation of  $K=k$  (with coordination cost) is at the other pole, where the coordination efficiency  $k$  is so low that people will choose autarky, no matter what they have done in period 1.

We assume that the partners just know the distribution of  $K$  [see (2.6)] before period 2, but know the value of  $K$  in period 2.

$$K = \begin{cases} 1, & \text{with probability } p \\ k, & \text{with probability } 1-p \end{cases} \quad (2.6)$$

According to Nash (1950), bargaining is decided by the optimum programming.

$$\begin{aligned} \max & (\sqrt{Kx_M y_M} - f_M)(\sqrt{Kx_F y_F} - f_F) \\ \text{st} & : x_M + x_F = x, y_M + y_F = y \end{aligned} \quad (2.7)$$

where  $x$  and  $y$  are the products which will be divided by the two players. For  $i=M$  and  $F$ ,  $x_i$  and  $y_i$  are the products that player  $i$  obtains from the bargaining, and  $f_i$  are the threat points of player  $i$  which denotes the maximum utility from autarky. Furthermore, for anyone, if the utility from the bargaining is less than the threat point, cooperation is not possible and hence players will choose autarky.

**Lemma 1** In Nash bargaining (2.7), we have

$$U_M = \begin{cases} \frac{\sqrt{Kxy} + f_M - f_F}{2}, & \text{if } \sqrt{Kxy} \geq f_M + f_F \\ f_M, & \text{if } \sqrt{Kxy} \leq f_M + f_F \end{cases} \quad (2.8a)$$

$$U_F = \begin{cases} \frac{\sqrt{Kxy} + f_F - f_M}{2}, & \text{if } \sqrt{Kxy} \geq f_M + f_F \\ f_F, & \text{if } \sqrt{Kxy} \leq f_M + f_F \end{cases} \quad (2.8b)$$

where  $U_M$  and  $U_F$  are the utilities from the Nash bargaining.

The proof of Lemma 1 is shown in Section 5. Lemma 1 shows that the couple will engage in the gender division of labor if and only if  $(Kxy)^{1/2} \geq f_M + f_F$  is satisfied. Otherwise they prefer autarky. As mentioned above, when  $K=k$ , we assume that  $k$  is so small that  $(kxy)^{1/2} < f_M + f_F$ , thus the players will prefer autarky. Besides, Lemma 1 shows that the player with larger threat point will get more shares from the allocated goods. Only when the players have the same threat point, they allocate the goods equally.

In this two-period model, the players engage in the Nash bargaining in each period. Since production in period 1 affect bargaining in period 2, and at the same time the bargaining in period 1 should takes the utilities from the subsequent bargaining in period 2 into account, we use backward deduction to analyze the bargaining in these two periods. In period 2, the form of the bargaining is the same as (2.7) in which the production in period 1 is given. In the Nash bargaining in period 1, they should take the utilities from the subsequent bargaining in period 2 into account. Thus the Nash bargaining is decided by the optimum programming:

$$\begin{aligned} & \max[(\sqrt{x_M y_M} + \delta U_{M2}) - (f_{M1} + \delta f_{M2})][(\sqrt{x_F y_F} + \delta U_{F2}) - (f_{F1} + \delta f_{F2})] \\ & \text{st: } x_M + x_F = x, y_M + y_F = y \end{aligned} \quad (2.9)$$

where  $x$  and  $y$  are the products which will be divided by the two players. For  $i=M$  and  $F$ ,  $x_i$  and  $y_i$  are the products that player  $i$  obtains from the bargaining.  $U_{i2}$  is the utility the player gets from the subsequent bargaining in period 2.  $f_{i1}$  is the utility from autarky in period 1 and  $f_{i2}$  is the utility from the subsequent bargaining in period 2.

Nash bargaining (2.9) is a special case of bargaining (2.7), where the players' threat points are (2.10a) and (2.10b) respectively.

$$f_M = f_{M1} + \delta f_{M2} - \delta U_{M2} \quad (2.10a)$$

$$f_F = f_{F1} + \delta f_{F2} - \delta U_{F2} \quad (2.10b)$$

From Lemma 1, we know the solutions of Nash bargaining (2.9).

**Corollary 1** In Nash bargaining (2.9)

If  $\sqrt{xy} + \delta(U_{M2} + U_{F2}) \geq (f_{M1} + \delta f_{M2}) + (f_{F1} + \delta f_{F2})$ , we have:

$$U_M = \frac{\sqrt{xy} + (f_{M1} + \delta f_{M2}) - (f_{F1} + \delta f_{F2}) + \delta(U_{M2} + U_{F2})}{2} \quad (2.11a)$$

$$U_F = \frac{\sqrt{xy} + (f_{F1} + \delta f_{F2}) - (f_{M1} + \delta f_{M2}) + \delta(U_{M2} + U_{F2})}{2} \quad (2.11b)$$

If  $\sqrt{xy} + \delta(U_{M2} + U_{F2}) \leq (f_{M1} + \delta f_{M2}) + (f_{F1} + \delta f_{F2})$ , we have:

$$U_M = f_{M1} + \delta f_{M2} \quad (2.12a)$$

$$U_F = f_{F1} + \delta f_{F2} \quad (2.12b)$$

where  $U_M$  and  $U_F$  are the present values of utilities from the Nash bargaining.



Next we will analyze the gender division of labor between unmarried couple and married couple respectively. In the next section, we will compare the two situations from which the effect of marital contracts on the gender division of labor is shown.

## 2.1 The gender division of labor between unmarried couple

From backward deduction, we first analyze the Nash bargaining in period 2. The players can choose the high degree of division of labor (H) and the low degree of division of labor (L) in period 1.

If the players choose L, each of them will input half unit of time in the production of X and the other half unit of time in the production of Y. In this case, the male's production functions in period 2 are:

$$x = A(1+0.5\alpha)l_x \text{ and } y = l_y \quad (2.13)$$

And the female's production functions in period 2 are:

$$x = (1+0.5\alpha)l_x \text{ and } y = Al_y \quad (2.14)$$

The production functions show that the male has comparative advantage in the production X. The male and the female will respectively specialize in the production of X and Y if they get larger utilities from bargaining than the utilities from autarky, otherwise they will choose autarky.

For the utility maximization in autarky, the player will input half unit of time in the production of X and the other half unit of time in Y. thus the male' and the female's threat points are respectively:

$$f_{M2} = f_{F2} = \frac{\sqrt{A(1+0.5\alpha)}}{2} \quad (2.15)$$

If the male and the female specialize in the production of X and Y respectively, the male will produce  $A(1+0.5\alpha)$  unit of X and the female will produce A unit of Y for allocation. There are two situations in period 2, they have high coordination efficiency ( $K=1$ ) and low coordination efficiency ( $K=k$ ). In the case with  $K=1$ , according to Lemma 1, they get larger utilities from the division of labor than that from autarky, the utilities from the bargaining are:

$$U_{M21} = U_{F21} = \frac{A\sqrt{1+0.5\alpha}}{2} \quad (2.16)$$

In the case with  $K=k$ , on the other hand, since we assume that the coordination efficiency is so low that people will choose autarky. In this case they get the utilities (2.15).

Now we analyze the Nash bargaining in period 1, which is in the form of optimum programming (2.9). From Corollary 1 we need to know several variables before solving the programming. First, since the players choose L, each of them inputs half unit of time in the production of X and the other half unit of time in Y, they totally produce  $0.5(1+A)$  units of X and  $0.5(1+A)$  units of Y for allocation.

Next, since the players in period 1 don't know the states but know the distribution [see (2.6)] of cooperation efficiency, thus they know the expected utilities from the bargaining in period 2:

$$U_{M2} = U_{F2} = (1-p) \frac{A\sqrt{1+0.5\alpha}}{2} + p \frac{\sqrt{A(1+0.5\alpha)}}{2} \quad (2.17)$$

Third, For the utility maximization in autarky, each players will input half unit of time in the production of X and the other half unit of time in Y. In this case, the players have the same threat point,

$$f_{M1} = f_{F1} = 0.5\sqrt{A} \quad (2.18)$$

The last is the utilities from the bargaining in period 2 consequent on autarky in period 1. Since the production times input in autarky are the same as in L, they have the same situations in period 2, and hence the expected utilities from the bargaining in period 2 are the same as the expected utilities in (2.17).

$$f_{M2} = f_{F2} = (1-p) \frac{A\sqrt{1+0.5\alpha}}{2} + p \frac{\sqrt{A(1+0.5\alpha)}}{2} \quad (2.19)$$

From Corollary 1 the present values of the utilities from the low degree of division of labor are:

$$U_{LM} = U_{LF} = \frac{1+A}{4} + (1-p) \frac{\delta A\sqrt{1+0.5\alpha}}{2} + p \frac{\delta \sqrt{A(1+0.5\alpha)}}{2} \quad (2.20)$$

After the analysis of the low degree of division of labor, we turn to the high degree of division of labor. The analyses are quite similar.

If the players choose H, according to the comparative advantage in period 1, the male will input one unit of time in the production of X, while the female will input one unit of time in the production of Y. In this case, the male's production functions in period 2 are:

$$x = A(1+\alpha)l_x \text{ and } y = l_y \quad (2.21)$$

And the female's production functions in period 2 are:

$$x = l_x \text{ and } y = Al_y \quad (2.22)$$

From the production functions, the male will keep his comparative advantage in the production of X, and hence the male and the female will respectively specialize in the production of X and Y if the gender division of labor is superior to autarky, otherwise they will choose autarky.

For utility maximization in autarky, each player will input half unit of time in the production of X and the other half unit of time in Y. Thus the male' and the female's threat points are respectively:

$$f_M = \frac{\sqrt{A(1+\alpha)}}{2} \quad (2.23a)$$

$$f_F = \frac{\sqrt{A}}{2} \quad (2.23b)$$

If the male and the female specialize in the production of X and Y respectively, the male will produce  $A(1+\alpha)$  unit of X and the female will produce  $A$  unit of Y for allocation. There are two situations in period 2, they have high coordination efficiency ( $K=1$ ) and low coordination efficiency ( $K=k$ ). In the case with  $K=1$ , according to Lemma 1, they get higher levels of utility from division of labor than that from autarky, the utility levels from the bargaining are:

$$U_{M21} = \frac{A\sqrt{1+\alpha} + 0.5\sqrt{A(1+\alpha)} - 0.5\sqrt{A}}{2} \quad (2.24a)$$

$$U_{F21} = \frac{A\sqrt{1+\alpha} - 0.5\sqrt{A(1+\alpha)} + 0.5\sqrt{A}}{2} \quad (2.24b)$$

In the case with  $K=k$ , on the other hand, since we assume that the coordination efficiency is so low that people will choose autarky. In this case they get the utilities in (2.23).

Now we analyze the Nash bargaining in period 1.

From Corollary 1 we need to know several variables before solving the programming. First, since the players choose H, the male will produce  $A$  unit of X and the female will produce  $A$  unit of Y for allocation.

Next, since the players in period 1 don't know the states but know the distribution [see (2.6)] of cooperation efficiency, thus they know the expected utilities from the bargaining in period 2:

$$U_{M2} = (1-p) \frac{A\sqrt{1+\alpha} + 0.5\sqrt{A(1+\alpha)} - 0.5\sqrt{A}}{2} + p \frac{\sqrt{A(1+\alpha)}}{2} \quad (2.25a)$$

$$U_{F2} = (1-p) \frac{A\sqrt{1+\alpha} + 0.5\sqrt{A} - 0.5\sqrt{A(1+\alpha)}}{2} + p \frac{\sqrt{A}}{2} \quad (2.25b)$$

Last, as mention above, if the players choose autarky in period 1, the players' maximum utilities in period 1 ( $f_{M1}$  and  $f_{F1}$ ) are (2.18), and the expected utilities from the bargaining in period 2 ( $f_{M2}$  and  $f_{F2}$ ) are (2.19).

From Corollary 1 the present values of the utilities from the high degree of division of labor are:

$$U_{HM} = U_{HF} = \frac{A}{2} + (1-p) \frac{\delta A \sqrt{1+\alpha}}{2} + \frac{p\delta}{2} \left[ \frac{\sqrt{A}}{2} + \frac{\sqrt{A(1+\alpha)}}{2} \right] \quad (2.26)$$

In period 1, they choose low or high degree of division of labor just according to which strategy will bring them with larger utility. Compared (2.20) with (2.26), we have Proposition 1, where the proof is shown in Section 5.

**Proposition 1** without a marital contract,

- (1) The couple may choose the low degree (L) or the high degree of division of labor (H) in period 1.
- (2) The degree of gender division of labor increases with the degree of comparative advantage between the male and the female ( $A$ ), and decreases with the divorce rate ( $p$ ).

## 2.2 The gender division of labor between a married couple

As shown in Subsection 2.1, the female's bargaining power is reduced by the gender division of labor. If the players choose autarky in period 1, they have the same threat point in the bargaining of period 2 [see (2.15)]. However, if they choose specialization according the comparative advantage, the female has the lower threat point than the male [see (2.23a,b)]. This causes that in some situations the players will get higher utilities from autarky than that from specialization in accordance to comparative advantage. In the next subsection we will analyze this problem further.

In this subsection we introduce alimony, one of the legal provisions in marital contract, for the compensation of the loss in gender division of labor. Since the players have the same threat point before specialization, we assume that if the cooperation is ceased the male needs to transfer part of income to the female until they have the same level of utility.

Now we analyze the gender division of labor under the protection of alimony. In period 1 the male and the female may choose the low degree (L) or the high degree of division of labor (H). If the players choose L, they have the same threat point in period 2 [see (2.15)]. That means the female doesn't need alimony if the cooperation is ceased. It is the same as the situation without marriage, thus their present values of utilities from the adoption of low degree of division of labor are (2.20).

If the players choose H, according to the comparative advantage in period 1, the male will input one unit of time in the production of X, while the female will input one unit of time in the production of Y. In this case, the male's and the female's production functions in period 2 are (2.21) and (2.22) respectively.

From the production functions, the male will keep his comparative advantage in the production of X, and hence the male and the female will respectively specialize in the production of X and Y if the gender division of labor is more beneficial than autarky, otherwise they will choose autarky.

For utility maximization in autarky, each player will input half unit of time in the production of X and the other half unit of time in Y. if there is no compensation, the male and the female's utilities are (2.23a) and (2.23b) respectively. Under the protection of alimony, we assume that the male has to transfer  $c$  unit of income to the female from which they have the same utility. Thus  $c$  satisfies:

$$\sqrt{\left(\frac{A(1+\alpha)}{2} - c\right) \frac{1}{2}} = \sqrt{\left(\frac{1}{2} + c\right) \frac{A}{2}} \quad (2.28)$$

$$\text{Thus } c = \frac{A\alpha}{2(1+A)} \quad (2.29)$$

and the male's and the female's threat points are respectively:

$$f_M = f_F = \frac{1}{2} \sqrt{\frac{A[1+A(1+\alpha)]}{1+A}} \quad (2.30)$$

If the male and the female specialize in the production of X and Y respectively, the male will produce  $A(1+\alpha)$  unit of X and the female will produce  $A$  unit of Y for allocation. There are two situations in period 2, they have high coordination efficiency

( $K=1$ ) and low coordination efficiency ( $K=k$ ). In the case with  $K=1$ , according to Lemma 1, they get larger utilities from division of labor than that from autarky, the utilities from the bargaining are:

$$U_{M21} = U_{F21} = \frac{A\sqrt{1+\alpha}}{2} \quad (2.31)$$

In the case with  $K=k$ , on the other hand, since we assume that the coordination efficiency is so low that people will choose autarky. In this case they get the utilities in (2.23).

Now we analyze the Nash bargaining in period 1. From Corollary 1 we need to know several variables before solving the programming. First, since the players choose H, the male will produce  $A$  unit of X and the female will produce  $A$  unit of Y for allocation.

Next, since the players in period 1 don't know the states but know the distribution [see (2.6)] of cooperation efficiency, thus they know the expected utilities from the bargaining in period 2:

$$U_{M2} = U_{F2} = (1-p) \frac{A\sqrt{1+\alpha}}{2} + \frac{p}{2} \sqrt{\frac{A[1+A(1+\alpha)]}{1+A}} \quad (2.32)$$

Last, as mentioned above, if the players choose autarky in period 1, the players' maximum utilities in period 1 ( $f_{M1}$  and  $f_{F1}$ ) are (2.18), and the expected utilities from the bargaining in period 2 ( $f_{M2}$  and  $f_{F2}$ ) are (2.19).

From Corollary 1 the players' present values of the utilities from the high degree of division of labor are:

$$U_{MX} = U_{MY} = \frac{A}{2} + (1-p) \frac{\delta A\sqrt{1+\alpha}}{2} + \frac{p\delta}{2} \sqrt{\frac{A[1+A(1+\alpha)]}{1+A}} \quad (2.33)$$

In period 1, the players will choose the low or the high degree of division of labor according to which strategy will bring them a higher level of utility. Comparing (2.20) with (2.33) we have Proposition 2, where the proof is shown in Section 5.

**Proposition 2** With marriage the male and the female always choose the high degree of division of labor in period 1.

### 3. Alimony and the gender division of labor

#### 3.1 The effect of hold up on the gender division of labor

There is a 'hold up' problem caused by the gender division of labor. The male and the female are endowed with comparative advantage, usually the male has comparative advantage in social production while the female in home production. That is why in various degrees there is the gender division of labor in a family. Although the division of labor enlarges the pie, it will reduce the female's threat point (the maximum utility in autarky) and hence put her in a disadvantage in the allocation of the family's output. This is the 'hold up' problem caused by the gender division of labor.

On the other hand, hold up impacts negatively on the gender division of labor. From the long-term interest, it is the balance of these two factors, the more reward from a larger pie and the less share of allocation in the future, in determining the division of labor. Given other conditions, the more bargaining power she will lose, the lower degree of division of labor she is willing to engage in.

There are some methods for eliminating or at least mitigating the 'hold up' problem caused by the gender division of labor, for example, customary (Lundberg and Pollak 1993, Baker and Jacobsen 2007), and social norm (Sevilla-Sanz 2005). Here we just compare two methods, fore-gift and alimony.

Paid before the division of labor for compensating the cumulative total loss in a lifetime, fore-gift is a method for eliminating the 'hold up' problem. In this model, for example, the couple knows that the female will suffer loss if they engage in the division of labor in period 1. Thus when they engage a bargaining for the time and goods allocation in period 1, the female will get some compensation for the expected loss caused by the division of labor. This is the fore-gift. As a result, the couple has the same expected present value of utilities, no matter there is or not the division of labor between them. It means that the 'hold up' problem is eliminated.

Alimony is one of the legal provisions in marital contract. Since alimony can be prescribed to keep the couple's bargaining power after the gender division of labor, the 'hold up' problem is eliminated. In this model, for example, the couple has the same bargaining power before the division of labor. Once the cooperation is ceased, alimony can be prescribed as follow: the male needs to transfer part of income to the female until they have the same utility. In this case, they have the same threat point after the division of labor, thus the output of the family will be allocated equally. Since the 'hold up' problem is eliminated, the couple is willing to intensify the division of labor during cooperation (see Proposition 2).

Now we compare the effects of alimony and fore-gift on the gender division of labor.

**Proposition 3** Compared with a fore-gift, the introduction of an alimony will not reduce the degree of gender division of labor. In some situations it will improve the degree of division of labor, and thus improve Pareto efficiency.

The proof is shown in Section 5. Proposition 3 shows that alimony is a more effective method than fore-gifts for promoting the division of labor. The lower efficiency of fore-gifts shows in two aspects: First, a fore-gift compensates the loss before the division of labor. Since the loss is uncertain or even unknown at that time, they can only compensate the expected loss at best, while alimony is confirmed at the time of divorce, when the information of the loss is revealed. For periodic support, the payment can be modified according to the situation of the time.

Next, with a fore-gift, the cumulative total loss in a lifetime is compensated before the division of labor. When the total loss is large, it will inevitably distort the distribution of consumption in their lifetime. While with alimony, say periodic support, ideally the loss is measured and compensated in each period: the larger the difference in threat points, the more income is transferred. In this case, the difference in the utility levels between the couple is eliminated by averaging their incomes, not by distorting their income.

The higher efficiency in compensation, the less Pareto efficiency is discounted. Compared with fore-gifts, therefore, alimony may improve the degree of division of labor, and thus improve the Pareto efficiency.

### **3.2 The reasons of alimony**

What is the reason of alimony? From an investigation in 1997, 65% of the interviewees believed that the alimony should be paid until the needed spouse “on feet”, 20% believed it should be paid until the needed spouse re-partner, and 5% said it was indefinite (Behrens and Smyth 1999, Table 8). It means that most people emphasize the function of temporal support in alimony. Consistent with this general opinion is the remarriage-termination rule, which makes remarriage as a significant or dispositive indicator for termination of alimony (Starnes 2006, p973).



If only temporal support is given in an alimony, it may be unreasonable in some cases. For example, in the case of Helen and Anthony (Starnes 2006 p974), they divorce after a marriage of twenty-six years. During marriage, Helen worked as a full-time homemaker and caretaker of the couple's children while Anthony pursued a career. At divorce, Anthony earned \$158,000 annually as a bank executive while Helen qualified for only unskilled, entry level positions at minimum wage. A divorce decree divided the couple's marital property; ordered Anthony to pay \$500 per week in alimony and \$300 per week in child support; and set Helen and Anthony free to begin new lives as single persons. Helen soon found work as a part-time medical assistant earning \$90 per week. One and one-half years later, Helen married again, and upon Anthony's petition, a court terminated her alimony.

Is it fair for Helen? Although people believe that an ex-husband should not pay for a former spouse who has married someone else, it is obviously unequal between the alimony for 1.5 years and the opportunity costs of a full-time homemaker and caretaker for 26 years. We have shown that the huge difference in earning power is, at least partly, caused by the gender division of labor during their marriage. For this reason, Helen should get compensation for her loss, whether she remarry or not.

Totally stopping alimony payments after a divorced women remarries causes inefficiency in two ways. First, it reduces the incentives for a woman to engage in efficient division of labour during marriage as her alimony will only last until she remarries. If the amount of alimony payment is determined at an appropriate level assuming no remarriage, the termination at remarriage will reduce the appropriate expected utility of engaging in efficient division of labor. Moreover, the losing parties from the remarriage-termination rule are not confined to directly affected persons like Helen, but to all families. If a young wife believes that the expected compensation cannot cover her loss from the gender division of labor, she will put excessive (compared to efficient division of labor) effort into the career of social production instead of into the family. Therefore, the family will suffer welfare loss due to insufficient division of labor.

Secondly, the remarriage-termination rule causes inefficiencies as it discourages divorced women with alimony payments from efficient remarriage due to the loss of alimony. Many women with alimony payments may refrain from efficient and happy marriages. Thus, the remarriage-termination rule, especially in its total termination aspect, is likely to be inefficient and unjustified.

Consider a situation where two persons A and B became partners in a business with equal contribution of capital investment. After a number of years, they decided to terminate the partnership. Due to the fact that A contributed more in terms of time investment in looking after the business, it was decided to have a 60-40 split of the assets of the business. Surely, if this split is reasonable, it should not depend on whether A starts another business in the future or not.

From the analyses above we argue that the compensation for the loss caused by the gender division of labor should be a reason of alimony and that the termination of alimony at remarriage may be inefficient.

#### **4. Conclusion**

The paper develops a two-period Nash bargaining model to explain a phenomenon: the gender division of labor between a married couple is more intensive than that between a unmarried couple (South and Spitze 1994).

The basic idea is that, the male and the female have different comparative advantages, usually the male has comparative advantage in the production of social products while the female in the production of housework. Although the division of labor enlarges the pie, it will reduce the female's threat point (the maximum utility in autarky) and hence put her in a disadvantage in the allocation of the family's output. This is the 'hold up' problem caused by the gender division of labor. From the long-term interest, the more bargaining power she will lose, the lower degree of division of labor she is willing to engage in. Since alimony can be prescribed to keep the couple's bargaining power after the division of labor, the 'hold up' problem is eliminated and hence the couple is willing to intensify the division of labor during cooperation.

As an application we discuss the reasons for alimony. Today alimony will be terminated if the former spouse remarries someone else. It is not only the general opinion but also a rule in marriage law, remarriage-termination rule. From the case of Helen (Starnes 2006), we argue that (temporal) support should not be the only reason of alimony, compensation for the loss caused by the gender division of labor should be another reason. We also argue that the remarriage-termination rule is inefficient in both causing insufficient division of labour within marriage and in discouraging divorced women with alimony payments from efficient remarriage.

However, from this model, the alimony loses its base in the absence of division of labor. For example, if a couple keeps their occupations and shares all the housework equally (for simplicity we assume that they have no children), no alimony is needed upon the dissolution of the family, though alimony from other reasons (Cohen 1987, Starnes 2006) may still be justified.

## 5. Appendix

**Lemma 1 Proof:**

The maximization (2.7) is equivalent to

$$\max\{\ln(\sqrt{Kx_M y_M} - f_M) + \ln[\sqrt{K(x-x_M)(y-y_M)} - f_F]\}$$

$$st: 0 \leq x_M \leq x, 0 \leq y_M \leq y$$

Thus we have the first-order conditions:

$$\frac{\sqrt{Ky_M}}{2\sqrt{x_M}(\sqrt{Kx_M y_M} - f_M)} = \frac{\sqrt{K(y-y_M)}}{2\sqrt{x-x_M}[\sqrt{K(x-x_M)(y-y_M)} - f_F]}$$

$$\frac{\sqrt{Kx_M}}{2\sqrt{y_M}(\sqrt{Kx_M y_M} - f_M)} = \frac{\sqrt{K(x-x_M)}}{2\sqrt{y-y_M}[\sqrt{K(x-x_M)(y-y_M)} - f_F]}$$

Thus

$$\frac{x_M}{y_M} = \frac{x-x_M}{y-y_M} \tag{5.1}$$

$$\sqrt{Kx_M y_M} - f_M = \sqrt{K(x-x_M)(y-y_M)} - f_F \tag{5.2}$$

Denoting  $x_M = \lambda x$ , from (5.1) we have  $y_M = \lambda y$ . And from (5.2) we have:

$$\lambda\sqrt{K} - f_M = (1-\lambda)\sqrt{K} - f_F$$

Thus

$$\lambda = \frac{\sqrt{K} + f_M - f_F}{2\sqrt{K}}$$

And we have

$$U_M = \begin{cases} \frac{\sqrt{Kxy} + f_M - f_F}{2}, & \text{if } \sqrt{Kxy} \geq f_M + f_F \\ f_M, & \text{if } \sqrt{Kxy} \leq f_M + f_F \end{cases}$$

$$U_F = \begin{cases} \frac{\sqrt{Kxy} + f_F - f_M}{2}, & \text{if } \sqrt{Kxy} \geq f_M + f_F \\ f_F, & \text{if } \sqrt{Kxy} \leq f_M + f_F \end{cases}$$

where  $U_M$  and  $U_F$  are the utilities from the Nash bargaining.

**Proposition 1 Proof:**

From (2.20) and (2.26), we have

$$\begin{aligned} & U_{HF} - U_{LF} (= U_{HM} - U_{LM}) \\ &= \sqrt{A} \left\{ \frac{A-1}{4\sqrt{A}} + \frac{(1-p)\delta\sqrt{A}}{2} (\sqrt{1+\alpha} - \sqrt{1+0.5\alpha}) - \frac{p\delta}{2} \left[ \sqrt{1+0.5\alpha} - \frac{1}{2} - \frac{\sqrt{1+\alpha}}{2} \right] \right\} \end{aligned} \quad (5.3)$$

Since  $\sqrt{1+\alpha x}$  is a concave function with respect to  $x$ . we have:

$$\sqrt{1+0.5\alpha} - \frac{1}{2} - \frac{\sqrt{1+\alpha}}{2} \geq 0$$

It is easy to see that the players may choose the low or the high degrees of division of labor. For example, when device rate ( $p$ ) approach to zero, utility  $U_{LF}$  is larger than utility  $U_{HF}$ . In this case, they will choose low degree of division of labor. In contrast, when the degree of comparative advantage ( $A$ ) and device rate ( $p$ ) approach to one, utility  $U_{HF}$  is larger than utility  $U_{LF}$ . In this case, they will choose high degree of division of labor.

From (5.3), it is easy to see that  $U_{HF}-U_{LF}$  increases with  $A$ , but decreases while  $p$  increase. Therefore, the larger the  $A$ , the more likely  $U_{HF}>U_{LF}$ . In addition, the larger the  $p$ , the more likely  $U_{LF}>U_{HF}$ . It means that the degree of comparative advantage ( $A$ ) is a positive factor, while device rate ( $p$ ) is an inverse factor of the gender division of labor.

**Proposition 2 Proof:**

With  $A \geq 1$ , we have:

$$1 + A(1 + \alpha) \geq (1 + A)(1 + 0.5\alpha)$$

Thus

$$\sqrt{\frac{A[1 + A(1 + \alpha)]}{1 + A}} \geq \sqrt{A(1 + 0.5\alpha)}$$

It is easy to see that (2.33) is larger than (2.20). Thus we have Proposition 2.

## References

- BARDASI, Elena and TAYLOR, Mark (2008). "Marriage and Wages: A Test of the Specialization Hypothesis", *Economica*, 75(299): 569-91.
- BAKER, Matthew J., and JACOBSEN, Joyce P. (2007). "Marriage, Specialization and the Gender Division of Labor," *Journal of Labor Economics*, 25: 763-93.
- BECKER, Gary S. (1985) "Human Capital, Effort, and the Sexual Division of Labor," *Journal of Labor Economics* 3: 33-58.
- BECKER, Gary S. (1991). *A Treatise on the Family*. Enlarged ed. Cambridge, MA: Harvard University Press.
- BEHRENS, J. and SMYTH, B. (1999). "Spousal Support in Australia, a Study of Incidence and Attitudes," working paper No.16, Australian Institute of Family Studies.
- BERGSTROM, Theodore C. (1996). "Economics in a Family Way," *Journal of Economic Literature* 34: 1903-34.
- BIRD, G. W., BIRD, G. A., & SCRUGGS, M. (1984). "Determinants of Family Task Sharing: A Study of Husbands and Wives," *Journal of Marriage and the Family* 46: 345-355.
- BLOOD, Robert O., and WOLFE, Donald, M. (1960). *Husbands and Wives: The Dynamics of Married Living*. Free Press.
- BRINES, J. (1994). "Economic Dependence, Gender, and the Division of Labor at Home." *American Journal of Sociology* 100: 652-88.
- BRING, Margaret F. and CRAFTON, Steven M. (1994), "Marriage and Opportunism," *The Journal of Legal Studies* 23: 869-94.
- COBB-CLARK, Deborah & CROSSLEY Thomas F. (2004). "Revisiting the family investment hypothesis", *Labour Economics*, 11: 373– 393.
- COHEN, L. (1987). "Marriage, Divorce, and Quasi Rents; or, 'I Gave Him the Best Years of My Life'," *The Journal of Legal Studies* 16: 267-303.
- COVERMAN, Shelly (1985). "Explaining Husbands' Participation in Domestic Labor," *Sociological Quarterly* 26: 81-97.
- ENGLAND, Paula and FARKAS, George (1986). *Households, Employment and Gender: A Social, Economic, and Demographic View*. Aldine.

- FAFCHAMPS, Marcel and QUISUMBING, Agnes R. (2003). "Social Roles, Human Capital, and the Intrahousehold Division of Labor: Evidence from Pakistan", *Oxford Economic Papers*, 55(1): 36-80.
- 
- HADFIELD, Gillian K. (1999). "A Coordination Model of the Sexual Division of Labor," *Journal of Economic Behavior and Organization* 40: 125-53.
- HERSCH, J. and STRATTON, Leslie S. (1994). "Housework, Wage, and the Division of Housework Time for Employed Spouse," *American Economic Review* 84: 120-25.
- HILLER, Dana V. (1984) . "Power Dependence and Division of Family Work," *Sex Roles* 10:1003-19.
- KAMO, Y. (1988). "Determinants of Household Division of Labor: Resources, Power, and Ideology," *Journal of Family* 9: 177-200.
- KONRAD, Kai A. and LOMMERUD, Kjell E. (1995). "Family policy with non-cooperative families," *Scandinavian Journal of Economics* 97: 581-601.
- KONRAD, Kai A. and LOMMERUD, Kjell E. (2000). "The Bargaining Family Revisited," *The Canadian Journal of Economics* 33: 471-87
- LUNDBERG, S. and POLLAK, Robert A. (1993). "Separate Spheres Bargaining and the Marriage Market," *Journal of Political Economy* 101: 988-1010.
- LUNDBERG, S. and POLLAK, Robert A. (1994). "Noncooperative Bargaining Models of Marriage," *American Economic Review, Papers and Proceedings* 84: 132-7.
- NASH, John F. (1950). "The Bargaining Problem," *Econometrica* 18: 155-62.
- ROSS, C. E. (1987) . "The Division of Labor at Home," *Social Forces* 65: 816-833.
- SECCOMBE, K. (1986). "The Effects of Occupational Conditions upon the Division of Household Labor: An Application of Kohn's Theory," *Journal of Marriage and the Family* 48: 839-848.
- SEVILLA-SANZ, Almudena (2005), "Social Effects, Household Time Allocation, and the Decline in Union Formation," working paper, Congressional Budget Office.
- SOUTH, Scott J. and SPITZE, G. (1994). "Housework in Marital and Nonmarital Households," *American Sociological Review* 59: 327-347.
- STARNES, Cynthia L. (2006). "One More Time: Alimony, Intuition, and the Remarriage-Termination Rule," *Indiana Law Journal* 81: 971-99.

WEISS, Y. and WILLIS, Robert J. (1985). "Children as Collective Goods and Divorce Settlements," *Journal of Labor Economics* 3: 268-92.