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EFFICIENCY IN MARRIAGE

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ABSTRACT

Economists usually assume that bargaining in marriage leads to efficient outcomes. The most convincing rationale for this assumption is the belief that efficient allocations are likely to emerge from repeated interactions in stationary environments, and that marriage provides such an environment. This paper argues that when a current decision affects future bargaining power, inefficient outcomes are plausible. If the spouses could make binding commitments -- in effect, commitments to refrain from exploiting the future bargaining advantage -- then the inefficiency would disappear. But spouses seldom can make binding commitments regarding allocation within marriage.

To investigate the efficiency of bargaining within marriage when choices affect future bargaining power, we consider the location decisions of two-earner couples. These location decisions are transparent and analytically tractable examples of choices likely to affect future bargaining power, but the logic of our analysis applies to many other decisions. For example, decisions about education, fertility, and labor force participation are also potential sources of inefficiency.

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Do married couples allocate family resources efficiently? Recent work on bargaining and other non-unitary models of marriage has abandoned the assumption that spouses act as if they possess a single, well-defined set of preferences, and instead analyzes the interactions of spouses with separate preferences.[1] In this paper we argue that one of the casualties of this paradigm shift from unitary to non-unitary models is the presumption that families are efficient. That is, the pursuit of private gains by husbands and wives, combined with limits on their ability to contract over future behavior, can lead to decisions that fail to achieve Pareto optimality.

Most economic models of family behavior assume an efficient allocation of resources, either by treating the married couple as a single agent or, as in cooperative game theory, by imposing efficiency as an axiom of the collective choice process. The use of cooperative game theory is appropriate when players can make binding, costlessly enforceable agreements, but the mechanism by which such agreements are enforced within families is not obvious. The most convincing rationale for employing cooperative game theory is the belief that efficient allocations are likely to emerge from repeated interactions in stationary environments, and that marriage often provides such an environment.[2] This belief, however, goes beyond the conclusion of the folk theorem that asserts that efficient solutions are subgame perfect Nash equilibria of repeated games, but does not assert that they are the only such equilibria or that efficient equilibria are more

[1] For a survey, see Lundberg and Pollak [1996].

[2] A negative rationale is provided by the desire to avoid specifying a non-cooperative bargaining game in terms of its rules, moves, and information structure. Shubik [1989, 103] expresses skepticism about the usefulness of noncooperative game theory for analyzing "complex, loosely structured social interaction," a category that surely includes marriage.

likely to be selected than inefficient equilibria. Finally -- and this is our focus -- the environment in which marital bargaining takes place is sometimes nonstationary.

Some decisions change the environment in which future bargaining takes place, advantaging one spouse relative to the other. To model such decisions, we must treat marriage not as a repeated game but as a non-stationary, multi-stage game. In the absence of a commitment mechanism, equilibria in such games need not be efficient. We focus on location decisions of two-earner couples because they are transparent and analytically tractable examples of choices likely to affect future bargaining power. The logic of our analysis, however, implies that other decisions that affect future bargaining strength--for example, decisions about education, fertility, labor force participation, and retirement--are also potential sources of inefficiency.

Using a simple two-stage model of a married couple's location decision, we show that marital decisions involving the future need not be efficient unless individuals can make binding agreements regarding their future actions, or unless they are able to make efficiency-inducing asset transfers. Since neither of these conditions is likely to hold in modern marriages, location decisions are potential sources of inefficiency.

I. Individual Investments, Intra-Family Allocation, and Efficiency

In the ordinary course of married life, men and women make many choices that affect the opportunities they will face in the future. Earning a degree, rearing a child, accepting or rejecting a job offer, retiring from a career position—each of these decisions will affect the relative returns to home and market time in future periods, and thus the allocation of time by husbands and wives. In the traditional unitary model of the

household in which family members pool their resources and maximize a single utility function, bargaining power is irrelevant, and investment decisions during marriage have no strategic implications. Not surprisingly, in the unitary model investment decisions are dynamically efficient. In bargaining models, however, an individual's share of family resources depends upon relative bargaining power and, therefore, on the individual's control of resources inside and outside the marriage. For example, a mother's interruption of employment to stay home with a young child will reduce her potential earnings and the value of her "threat point", and may limit her claims to family resources in the future. Can such dynamic bargaining effects lead to inefficiency—in this case by discouraging efficient specialization and division of labor between parents? Or do families' incentive structures ensure dynamic efficiency?

We show that efficiency in dynamic marital bargaining requires binding agreements that are seldom feasible in modern marriages. Although we do not rely on a particular bargaining model, we do assume that individuals' earnings affect allocation and distribution within marriage. As an example, we consider the problem of a two-earner couple choosing a city of residence. We assume that the location, once chosen, will advantage one spouse relative to the other in future bargaining, and that this is perfectly foreseen. In the first stage, the location is determined; in the second, resources are allocated within marriage. Recognizing that the allocation in the second stage depends upon the location determined in the first, each spouse prefers the location that offers him or her the better outcome in the second-stage game. Even if the second-stage allocation is characterized by conditional efficiency (i.e., is efficient conditional on the location choice), the solution to the two-stage game may not be efficient in an unconditional

sense—that is, there may be technically feasible allocations at the other location that would make both spouses better off. This inefficiency might be avoided in one of two ways: the couple could enter into a binding agreement concerning the second-stage allocation, or the advantaged spouse could make an efficiency-inducing asset transfer. In fact, neither of these mechanisms is available to most married couples. Contracts regarding within-marriage distribution of resources are not legally binding or enforceable by the courts, and asset transfers are unlikely to be feasible for couples without substantial wealth.[3]

Other papers that explore the implications of limited commitment in dynamic bargaining models of the family include Ligon [2000] and Basu [2001]. Ligon explores the implications of adding an additional 'individual rationality' axiom to the Nash bargaining problem. This requires that neither agent can be made strictly worse off by continuing the bargaining relationship than by discontinuing it. In a dynamic problem, an ex ante Pareto optimal solution may not satisfy individual rationality, so Ligon replaces the Pareto optimality axiom with a 'constrained Pareto optimality' condition. This new set of axioms is satisfied by a class of solutions in which agents efficiently divide any surplus from the relationship according to an invariant sharing rule unless using this rule would make one agent worse off than she would be on her own. The division of surplus will then change so as to make this agent just indifferent between remaining in the relationship and leaving. This formulation allows limited commitment of a very specific sort—permitting renegotiation of the sharing rule only when one partner would be better off outside the relationship.

[3] We show in Section III that asset transfers, even when they are feasible, induce efficiency only under stringent conditions.

Basu examines a set of models in which the household balance of power is endogenously determined and there is no intertemporal commitment. If the household maximizes a weighted average of husband's and wife's utility, and the outcomes in one period (e.g., wife's labor supply) affect the bargaining weights in the future, then strategic considerations can lead to inefficient outcomes. Basu constructs some interesting illustrative models, showing how endogenous bargaining power can influence the evolution of women's labor supply and the prevalence of child labor.

II. The Two-Earner Couple's Location Problem

To illustrate the inefficiencies that may arise in dynamic bargaining, we consider a simple two-stage model of marriage and migration.[4] At each location, the spouses receive utility payoffs that depend on a conditionally efficient sharing rule. Chiappori [1988] introduced "efficient sharing rules" to analyze single-stage allocation decisions; we assume efficient sharing in the second stage of our two-stage model.

We assume that the sharing rule depends on earnings and interpret this as a reflection of bargaining power but we do not explicitly model the bargaining that takes place at the second stage (i.e., after the location has been determined). Nash bargaining in the second stage is a special case within this general framework.

The couple begins with jobs together in location 0. One spouse receives a job offer in location 1 with higher earnings than in location 0: we call him the leading spouse,

[4] Mincer [1978], the seminal paper on family migration, assumes a unitary model. Costa and Kahn [2000] argue that highly educated two-earner couples ("power couples") tend to locate in large cities to solve their co-location problem.

or L. His partner also receives a job offer in location 1, but with lower earnings than at location 0—call her the trailing spouse, or T.[5]

In the first stage game, husband and wife each decide on a location, choosing between two alternative moves, Stay and Go. If both choose Stay or both choose Go, then the couple remains married; if they make inconsistent choices, then the marriage ends in divorce. We assume that the first-stage game is non-cooperative, and consider both sequential move and simultaneous move versions. In the second stage, if the couple remains married, the sharing rule allocates resources efficiently, conditional on location. All consumption takes place in the second stage and we assume that all consumption is private, ignoring household public goods and all forms of interdependent preferences, including altruism. Each spouse derives utility from the marriage and, because of the assumed absence of household public goods and interdependent preferences, this utility bonus is the only source of gains to marriage.

We require a preference specification that enables each spouse to compare levels of consumption across marital states and locations. To permit a comparison of risky alternatives in section III, we introduce von Neumann-Morgenstern utilities. The utility function of spouse i is

$$V^i = \delta_n U^i_{M0} + \delta_a \alpha U^i_{D0} + \delta_b \beta U^i_{M1} + \delta_g \gamma U^i_{D1} \qquad (1)$$

where the first subscript on the U's denotes marital status (M for married, D for divorced), and the second the location (0 or 1). The δ's are equal to one if the individual is in the applicable marital state and location, and equal to zero otherwise. Without

[5] For ease of exposition, we adopt the traditional version of this problem in which the husband is the leading spouse, but recognize that for many couples this gender classification will be reversed. Although the language we use to describe our model identifies one location as the status quo, this asymmetry plays no role in our analysis.

further loss of generality, we can normalize each utility function so that $n_i = 1$. This normalization implies that, if the couple remains married in location 0, their utility possibility frontier has a slope of –1. However, if the couple remains married and moves to location 1, the slope of their utility possibility frontier is $-b_L/b_T$. Parallel utility-possibility frontiers would simplify our analysis of efficiency, since the efficient location is unambiguously the location corresponding to the outer frontier, but parallel frontiers cannot be obtained without restrictions on preferences over states. The frontier in the new location will be parallel to that in location 0 if and only if $b_L = b_T$. For the balance of this section, we assume that $a_i = b_i = g_i = 1$ for $i = L,T$; we relax this assumption in section III.

We assume that the *U*'s are linear in consumption. More specifically, we assume that $U^i_{Dj} = c^i_{Dj}$, where c^i_{Dj} is the consumption of individual i in location j when divorced and $U^i_{Mj} = c^i_{Mj} + M^i$ where c^i_{Mj} is the consumption of individual i in location j when married and M^i the utility bonus individual i derives from the marriage. Under these assumptions, preferences for location depend only on consumption and marital status.[6]

Total household consumption is equal to total household earnings. The earnings of spouse i in location j is denoted Y^i_j, where $Y^L_1 = Y^L_0 + g^L$ and $Y^T_1 = Y^T_0 + g^T$ where g^i is the gain in earnings associated with moving to the new location. By assumption, $g^L > 0$ and $g^T < 0$, so that if both spouses move to the new location, the leading spouse's earnings increase and the trailing spouse's earnings decrease. Hence, if the

[6] In Section III, we allow individuals to have intrinsic preferences for location.

spouses remain married in location 0, their utility possibility frontier has a slope of -1 and is given by

$$V^L + V^T = U^L_{M0} + U^T_{M0} \leq Y^L_0 + Y^T_0 + M^L + M^T = R_0 \qquad (2)$$

Because the utility bonuses individuals derive from marriage cannot be transferred from one spouse to the other, the utility-possibility frontier corresponds to the segment satisfying $V^L \geq M^L$ and $V^T \geq M^T$. Unless otherwise noted, we assume that all solutions lie on this segment.[7] If the spouses remain married in location 1, their utility possibility frontier is given by

$$V^L + V^T = U^L_{M1} + U^T_{M1} \leq Y^L_1 + Y^T_1 + M^L + M^T = R_1 \qquad (3)$$

If the individuals choose different locations, the result is divorce and the utilities are proportional to individual earnings.

For definiteness, we assume that $g^L + g^T \geq 0$, which implies that the frontier corresponding to location 1 lies outside the frontier corresponding to location 0. This assumption plays no role in our analysis of equilibrium, but it does imply that the efficient solution to the first stage game is either divorce or moving to the new location: every point on the inner frontier is Pareto dominated by some point on the outer frontier. The contrary assumption, $g^L + g^T < 0$ would not change our analysis of equilibrium, but would interchange the efficiency implications of various cases in the obvious way.

After the location has been determined, the husband and wife share total utility (R_j), where the sharing rule depends upon his earnings and her earnings. Given our

[7] Alternatively, we can view married couples as cooperating to produce output ("marital surplus") that they allocate between them, in the spirit of Becker's [1991, Ch. 4] household production specification. Becker's transferable output specification and our nontransferable utility bonus specification coincide provided the equilibrium in our model lies on the segment satisfying $V^L \geq M^L$ and $V \geq M^T$.

functional form assumptions, it is legitimate to speak in terms of shares of total utility. The leading spouse receives a share $s_j = s(Y_j^L, Y_j^T)$ of total utility in city *j*, and the trailing spouse receives $(1-s_j)$. Therefore, the utility of the leading spouse of marriage in location j will be:

$$U_{Mj}^L = c_{Mj}^L + M^L = s_j R_j = s_j (Y_j^L + Y_j^T + M^L + M^T)$$

while the utility of being single in location j is $U_{Dj}^L = c_{Dj}^L = Y_j^L$. We assume that each individual's share of total utility is increasing in own earnings, so that $s_1 > s_0$. (This assumption is consistent with divorce-threat bargaining.) The normal (i.e., strategic) form of the game maps the strategies Stay and Go into utility payoffs, giving the payoff matrix:

Trailing Spouse

Leading Spouse		**Stay**	**Go**
	Stay	$(U_{M0}^L, U_{M0}^T) = (s_0 R_{0,} (1-s_0) R_0)$	$(U_{D0}^L, U_{D1}^T) = (Y_0^L, Y_1^T)$
	Go	$(U_{D1}^L, U_{D0}^T) = (Y_1^L, Y_0^T)$	$(U_{M1}^L, U_{M1}^T) = (s_1 R_{1,} (1-s_1) R_1)$

The crucial feature of this example is that the couple cannot enter into a binding contract at the first stage to transfer earnings, alter the second-stage game, or alter the second-stage sharing rule. Thus, the location determines not only the couple's utility-possibility frontier but also, because the sharing rule depends on earnings, a particular point on the frontier. The trailing spouse will receive a greater share of total utility in the initial location, but total utility -- a well-defined notion because of our functional form assumptions -- will be greater if they move to the new location. If the increase in total

utility is sufficiently large that the trailing spouse would rather receive a smaller slice of a bigger pie, then there will be no conflict, and the strategy choices {Go, Go} will result in an outcome Pareto-superior to {Stay, Stay}. If, however, the trailing spouse would rather receive a larger slice of the smaller pie, then there are two ways in which the equilibrium location choice might be inefficient. First, if the leading and trailing spouses both decide to stay in the initial location, then the equilibrium will be on the inner frontier, Pareto-dominated by points on the frontier corresponding to the new location. Second, if the leading spouse decides to go and the trailing spouse decides to stay, then the result is divorce and the loss of the utility bonus that the spouses derive from the marriage, $M^L + M^T$; this divorce equilibrium may be Pareto-dominated by points on the frontier corresponding to the new location. Divorce, however, may be efficient; the gains to each member of the couple at his or her best labor market location may exceed the lost marital bonus.

The first-stage location decision will depend upon each spouse's preference ordering of the four possible outcomes.[8] The locational choices, which we denote by S (Stay) and G (Go), uniquely determine the outcome, and we can translate preferences over outcomes to preferences over strategy pairs. For example, GS denotes the case in which the leading spouse chooses Go and the trailing spouse chooses Stay and leads to the utilities associated with divorce, while GG denotes the case in which both spouses choose the new location and leads to the utilities determined by the sharing rule at the new location.

[8] The equilibrium of the first-stage game may also depend on how risk averse the spouses are and, hence, on the unconditional von Neumann-Morgenstern utility functions (1). If the sharing rule in the second-stage game reflects Nash bargaining, we need conditional von Neumann-Morgenstern utility functions at each location.

Although there are a large number of possible preference profiles for each couple, very few of them are interesting. We restrict our attention to the case of strict preference orderings (i.e., no ties) among the four outcomes. Under this assumption, there are 4! = 24 possible preference orderings for each spouse and, hence, 24 x 24 = 576 possible preference profiles for each couple. Our assumptions about earnings gains and losses from moving and utility gains from marriage allow us to ignore most of these as too obvious to warrant discussion. We assume that the leading spouse prefers to remain married and relocate (and thus prefers GG to the three other first-stage outcomes) while the trailing spouse prefers to remain married and not relocate (and thus prefers SS to the three other first-stage outcomes). That is, we ignore the cases in which one or both spouses prefer divorce to all other alternatives and cases in which both spouses prefer the same location. Conditional on divorce, the leading spouse prefers the new location (and thus prefers GS to SG), while the trailing spouse prefers the current location (and thus prefers SG to GS).[9] This implies that the leading spouse has preferences of the form (GG,GS,SS,SG) or (GG,SS,GS,SG), while the trailing spouse has preferences of the form (SS,GS,GG,SG) or (SS,GG,GS,SG). For each spouse, the only degree of freedom is the ranking of the second and third place alternatives: being divorced at the better location, and remaining married at the worse location. Thus, we can fully characterize each spouse's preferences by his or her second ranked alternative. Hence, of the 576 possible

[9] If the spouses care whether they both live in the same city after divorce (e.g., to facilitate maintaining contact with their children), then we must distinguish among four divorce outcomes, each specifying the location of both spouses. We ignore this possibility.

preference profiles, we can restrict our attention to 4:

Case 1. {(GG,GS,...), (SS,GG,...)}.

Case 2. {(GG,SS,...), (SS,GS,...)}.

Case 3. {(GG,GS,...), (SS,GS,...)}.

Case 4. {(GG,SS,...), (SS,GG,...)}.

We consider three alternative specifications of the noncooperative first-stage game. In all three specifications, each spouse has two moves, Go and Stay. Our first two specifications are sequential, and the third is simultaneous.

(A) A sequential game in which the leading spouse moves first. In effect, the leading spouse can commit himself to going to the new location.

(B) A sequential game in which the trailing spouse moves first. In effect, the trailing spouse can commit herself to staying in the current location.

(C) A simultaneous move game in which each spouse has two strategies, "Go" and "Stay."[10]

Case 1: Unambiguous {Go, Go}

If the leading spouse prefers moving to the new job without his partner to staying in the current location with her, (GG,GS,...), while the trailing spouse prefers moving and accepting a reduction in earnings to staying behind and divorcing, (SS,GG,…), then {Go,

[10] We assume that preferences are common knowledge. Hence, moves in the first-stage game do not convey information about preferences, and it is not news when your spouse makes a move indicating that he (she) would rather divorce than go (stay) with you. By dropping the assumption that spouses know their own and the other's preferences, we could add realism and complexity, and perhaps gain insight into the dynamics of marital negotiation. But whatever the advantages of relaxing the common knowledge assumption, banishing inefficiency is not among them.

Go} is the equilibrium in all three games (i.e., the simultaneous move game, the sequential game in which the leading spouse is first mover, and the sequential game in which the trailing spouse is first mover). The couple relocates to the new city, which is efficient in the sense that it corresponds to the outer utility-possibility frontiers, but the move makes the leading spouse better off and the trailing spouse, whose bargaining position has deteriorated, worse off.

Case 2: Unambiguous {Stay, Stay}

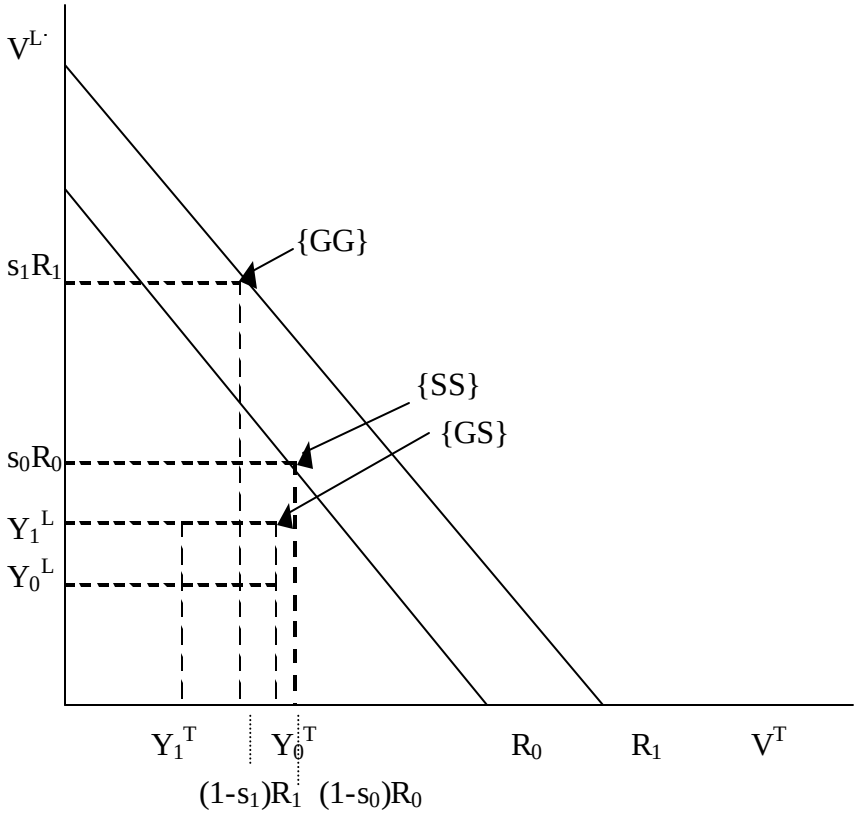
If the leading spouse prefers staying at the current location with his spouse to moving without her, (GG,SS,…), but the trailing spouse prefers divorce to relocating and remaining married, (SS,GS,…), then {Stay, Stay} is the equilibrium in all three games. This equilibrium is inefficient; every equilibrium on the frontier corresponding to the current location is Pareto-dominated by some point on the relocation frontier. But unless the trailing spouse can be compensated for the loss she would suffer by relocating, either through a transfer conditional on relocating or a contract regarding second-stage allocations, the couple will be unable to attain an allocation in the new location that both would prefer to the status quo.[11] The figure illustrates this case.

Case 3: Unambiguous {Go, Stay} (i.e., Divorce.)

If the leading spouse prefers moving to the new job without his partner to staying in the current location with her, (GG,GS,...), while the trailing spouse would rather divorce and stay than remain married and go, (SS,GS,…), then the equilibrium in all three games is {Go, Stay}. Divorce is the dominant strategy equilibrium in Case 3, and it may be efficient or

[11] The frontier corresponding to the new location lies outside the frontier corresponding to the initial location only because we have assumed it does. The efficiency results are reversed in the mirror image case in which relocation is assumed to be inefficient, but in which relocation is the equilibrium outcome.

inefficient. If the utility bonuses one or both spouses derive from the marriage are small and the earnings differences between locations (for one or both spouses) are large, then divorce is the efficient outcome. But divorce and the loss of the marital utility bonuses can also be the equilibrium when divorce yields utilities that are interior to the frontier corresponding to the new location. Under these circumstances, the couple's inability to contract regarding the second-stage outcome prevents them from attaining an outcome that both would prefer to divorce.



Case 2 -- Unambiguous {Stay, Stay}

Some calculations clarify the boundary between efficient and inefficient divorce. If the couple remains married and relocates, the utility possibility frontier is defined by $R_1 = Y_1^T + Y_1^L + M^T + M^L = Y_0^T + g^T + Y_0^L + g^L + M^T + M^L$. If the couple divorces, then the frontier is given by $R_D = Y_0^T + Y_1^L = Y_0^T + Y_0^L + g^L$, because each chooses the location that maximizes his or her individual earnings. If $R_D > R_1$, or equivalently if $-g^T > M^T + M^L$, then the divorce point lies above the utility possibility frontier in the new location, and divorce is the efficient outcome.[12].

But the conditions for efficient divorce are not the conditions for divorce. The couple will divorce if (a) the second stage division, if they relocate, fails to give the trailing spouse enough to remain in the marriage and (b) the second-stage division, if they remain in the current location, fails to give the leading spouse enough to remain in the marriage. In our notation, divorce occurs if, for the trailing spouse $Y_0^T > (1-s_1)R_1$ and for the leading spouse $Y_1^L > s_0 R_0$. For example, if the second-stage division is determined by Nash bargaining, which divides the sum of the utility bonuses equally between the spouses, then divorce will be the outcome when $-g^T > \frac{1}{2}(M^T + M^L)$ and $g^L > \frac{1}{2}(M^T + M^L)$. If the earnings loss the trailing spouse would experience by relocating lies in the range $\frac{1}{2}(M^T + M^L) < -g^T < (M^T + M^L)$ and the earnings gain the leading spouse would

[12] $R_D > R_1$ implies $R_D > R_1$ because of our assumption that $g^L > g^T$.

experience by relocating are greater than 1/2 the marital surplus, $g^L > \frac{1}{2}(M^T + M^L)$, then an inefficient divorce will be the dominant strategy equilibrium.[13]

Case 4: The "Battle of the Sexes" : indeterminate outcome.

We now consider the case in which each spouse prefers remaining married at the less-favored location to divorce. With these preferences, the solution to the first stage game depends on the rules of the game and the solution concept employed. In a sequential game, the first mover now has an advantage: if the leading spouse is first mover, the equilibrium is {Go,Go}, while if the trailing spouse is first mover, the equilibrium is {Stay,Stay}. The simultaneous move game is equivalent to the classic "battle of the sexes" game, in which both parties prefer remaining married regardless of location to being divorced, but prefer different marital locations.[14] This coordination game has two pure strategy equilibria, {Go,Go} and {Stay,Stay}, one efficient and one inefficient. Without resolving the equilibrium selection problem, we cannot say which pure strategy equilibrium will emerge and, hence, we cannot address the efficiency of equilibria in the simultaneous move game.[15] [16]

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[13] It is interesting to compare this result with the inefficient divorces that occur in the Peters [1986] model when asymmetric information about opportunities outside the marriage prevents ex post bargaining over the marital surplus.

[14] The canonical battle of the sexes story relies heavily on gender stereotypes. Both the husband and wife want to spend the evening together, but the husband wants to go to a sporting event (for example, a prize fight) and the wife to a cultural event (for example, a ballet). The story is used to motivate a noncooperative nonzero sum game in which the Pareto optimal outcomes correspond to successful coordination (that is, both go to the prize fight or both go to the ballet) and are Nash equilibria.

[15] The simultaneous move game also has a mixed strategy equilibrium, which is inefficient. In the mixed strategy equilibrium, the probability of playing each strategy depends on the von Neumann-Morgenstern utilities, not merely on the ordinal preferences.

[16] Focal points may be crucial in equilibrium selection and the status quo provides a "natural" focal point. Under our assumptions, the status quo is the inefficient location, but we could equally well have assumed that it is the efficient location. In the symmetric case in which the spouses must leave their current location (e.g., the Garden of Eden) and move to one of two new locations, neither alternative corresponds to the status quo. But few situations are entirely symmetric, and the absence of a status quo does not imply the absence of a focal point.

In Cases 1-3, the first-stage game yields a unique equilibrium that is independent of the rules of this game, at least for the three first-stage games we consider. In fact, in these three cases our conclusions about the equilibria depend more on our assumptions about preferences or payoffs and less on the rules of the game than might at first appear. In Case 3, divorce is a dominant strategy equilibrium; in Cases 1 and 2, the solutions follow from iterated dominance (i.e., the player with a dominant strategy is assumed to play it, and the other player is assumed to play his or her best response to the dominant strategy.) Uniqueness and independence of this sort are not general features of two-stage games, but a consequence of our special assumptions about preferences

What are the take-home lessons of our simple two-stage location games? First, each game must be analyzed to see whether its equilibria are efficient. Second, potentially Pareto-improving moves will not necessarily take place: in multi-stage household bargaining without a commitment mechanism, there is no presumption of dynamic efficiency.

III. Extensions

(a) Inducing Efficiency: Commitments, Transfers, and Social Norms

We can modify our two-stage game to ensure efficiency by reformulating it as a one-stage cooperative game or as a noncooperative game all of whose equilibria are efficient. As an example of a cooperative reformulation, consider the Nash bargaining solution to the game in which the threat point is divorce. Alternatively, consider the Nash bargaining solution to the game in which the threat point is the equilibrium of our two-stage

noncooperative game. Both approaches collapse our two-stage noncooperative game into single-stage cooperative games whose solutions are, by assumption, efficient.

As an example of a noncooperative reformulation, consider an analogue of the altruist model in which one spouse -- the altruist -- can at the outset confront the other spouse with a take-it-or-leave-it offer. The equilibrium of this single-stage game maximizes the altruist's utility subject to the constraint that the other spouse receives enough to remain in the marriage, unless the altruist prefers divorce to the solution to this constrained maximization problem. The equilibrium utility levels of the spouses and, if the frontiers intersect, perhaps also the equilibrium location, depend on which spouse can confront the other with a take-it-or-leave-it offer. In the absence of interdependent preferences, the game in which one spouse can confront the other with a take-it-or-leave-it offer implies an equilibrium in which the utility of the other spouse is driven down to his or her reservation level.

Neither the two cooperative games nor the cooperative games described above correspond to subgame perfect equilibria of our original two-stage game and, hence, all three reformulations require the assumption that at least one spouse can make binding commitments. The required assumptions about commitments, however, differ in the cooperative and the noncooperative versions. In the cooperative reformulations, or at least in the informal stories that are usually told to motivate cooperative game theoretic models, the ability of the players to make binding agreements and forego the possibility of renegotiating is crucial. In the noncooperative model, one spouse -- the altruist -- has the ability to threaten the other spouse with divorce. Commitment is required because the altruist would not want to carry out the threat if called upon to do so -- or, to restate the point

in terms of our two-stage game, the altruist's threat to divorce is not credible. Noncooperative games based on other unilateral threats, including threats of violence, are also of interest, although they do not necessarily ensure efficiency. So are reformulations based on unilateral promises, for example, promises to limit the extent to which a spouse will exploit in the second stage the bargaining advantages that arise from the location determined in the first stage (e.g., promising the other spouse a specified utility level at a particular location). These noncooperative scenarios require that one spouse have the ability to make unilateral commitments -- threats or promises -- not that spouses have the ability to make binding bilateral agreements.

Under what conditions can up-front asset transfers induce efficiency in two-earner couple location decisions? Becker [1991, Ch. 4] considers an analogous question in marriage markets. Becker notes that the efficient matching of men and women may not be achieved if rigidities in the socially acceptable distributions within marriage prevent prospective spouses from achieving a division of the marital surplus consistent with clearing the marriage market. Becker interprets dowry and bride price as lump-sum inducements to marry and argues that they are capable of providing the necessary adjustment mechanism when the appropriate ex post division cannot be guaranteed ex ante. Even if we accept Becker's interpretation and analysis of dowry and bride price, however, we see no analogous asset transfer mechanisms currently in use in developed countries.[17]

The threshold issue for up-front asset transfers is feasibility: do spouses have sufficient wealth to offset the losses that the disadvantaged spouse would experience by

[17] Zhang and Chan [1999] argue that dowry and bride price are fundamentally different because dowry goes to the new couple, while bride price goes to their parents' generation.

relocating or failing to relocate? Or, if the spouses lack sufficient wealth, can they borrow? The lack of wealth, together with borrowing constraints, rule out ex ante asset transfers for less affluent couples. Furthermore, even couples with sufficient wealth may find it difficult to make legally binding asset transfers (e.g., in community property states).

For couples with sufficient assets who can overcome the legal obstacles, under what conditions will asset transfers ensure efficiency? First, the asset transfer must be conditional on location, just as dowry and bride price are conditional on marriage. For example, in Case 3, where the equilibrium outcome is divorce, the leading spouse might transfer assets to the trailing spouse in return for an agreement by the trailing spouse to relocate; but the trailing spouse must be able to commit to relocating in exchange for the transfer: she cannot take the money and refuse to relocate. Thus, we require not only the ability of the spouses to transfer assets but also the ability to make agreements about location, if not the distribution of resources conditional on location.

Finally, the distinctions among agreements to transfers assets, agreements to transfer earnings, and agreements regarding the allocation of consumption in the second-stage game are tenuous. The proper generalization of our model to include assets as well as earnings requires reinterpreting the Y's in the sharing rule as the sum of the flow of income from assets and income from earnings. More precisely, if assets generate flows of income that continue forever and if earnings are flows that continue forever, then transferring claims to assets and transferring claims to earnings are essentially equivalent not only in their effects but also in the commitment assumptions required to implement them. Thus, the assumption that in the first-stage game the spouses can make binding

agreements regarding asset transfers is very close to the assumption that they can make binding agreements regarding earnings transfers and very close to contradicting the assumption that they cannot make binding agreements regarding future consumption.[18]

Norms and social institutions may mitigate some of the dynamic inefficiencies in family life, but norms and institutions are rather blunt instruments. Arrow [1974] argues that professional norms or ethics mitigate the inefficiencies created by asymmetric information in the dealings of lawyers with clients and physicians with patients. Social norms may play a similar role in regulating behavior within marriage, although norms may be most effective in traditional societies both because informal sanctions used to enforce norms are likely to be most effective in such societies and because differences across couples are relatively small. In nontraditional societies, on the other hand, the potential gains and losses to migration and other dynamic investment decisions are too heterogeneous across couples to admit of across-the-board remedies that rely on rigid social norms or legal rules. For example, if child rearing disadvantages most women in future marital bargaining, the negative effect on fertility incentives might be offset by changes in custody and support standards that increase maternal bargaining power in marriage. As the labor force participation behavior of mothers becomes more variable across married couples, however, the balance between the strategic losses and gains due to child rearing will differ from one couple to another. Furthermore, long-run marriage market effects might offset the short-run effects of changes intended to affect bargaining power within marriage.[19]

[18] A richer model would recognize that claims on a spouse's future earnings raise moral hazard concerns.
[19] Lundberg and Pollak [1993] show how the short-run effect of a change in government policy might be offset in the long run by the marriage market.

(b) Generalizing the Utility Functions: Locational Preferences

We now relax our assumption that individuals care about location only to the extent that one location offers a higher level of consumption than the other. We consider two elementary ways of relaxing this assumption, one based on additive parameters analogous to the marriage utility bonus, and the other based on multiplicative parameters--the β's from equation (1).

To introduce additive parameters we write $U^i_{Dj} = c^i_{Dj} + T^i_j$ and $U^i_{Mj} = c^i_{Mj} + M^i + T^i_j$, where T^i_j is the utility bonus individual i derives from location j. We assume that the sharing rule depends on $Y^i_j + T^i_j$, the sum of earnings and the locational utility bonus. Under this assumption, an increase in a spouse's location-specific earnings and an increase in that spouse's locational utility bonus have identical effects on equilibrium.[20] Thus, the additive specification of locational preferences does not substantially alter our analysis.[21]

The multiplicative specification of locational preferences allows intersecting utility-possibility frontiers, while our earlier assumption that $b_L = b_T$ ensured parallel utility-possibility frontiers. With unequal β's, for some values of Y^L_0 and Y^T_0 the frontiers intersect in the relevant range.[22] With intersecting frontiers, we distinguish between two cases. In the first case, the equilibrium is Pareto-dominated by points on the other frontier and we can conclude immediately that the equilibrium is inefficient. In the second case, the equilibrium

[20] With one caveat: the locational utility bonus, like the marriage utility bonus, cannot be transferred from one spouse to the other, so equivalence holds only on the segment of the utility-possibility frontier on which both spouses have strictly positive consumption.

[21] An alternative assumption is that the sharing rule depends only on each spouse's location-specific earnings. Because the locational utility bonuses are not lost in the event of divorce or a noncooperative marriage, we prefer the assumption in the text which, in effect, treats them like earnings rather than like the marital surplus--in Nash bargaining terms, they are components of the threat point.

[22] Nonparallel frontiers that intersect outside the relevant range present no new issues: all points on the inner frontier are inefficient and all points on the outer frontier are efficient.

is not Pareto-dominated by any point on the other frontier; it is, however, Pareto-dominated by a probability mixture of points in the two utility possibility sets. If we interpret efficiency in terms of expected utility, then the utility possibility set is the convex hull of the two locations' utility possibility sets and efficiency requires randomization: heads we relocate, tails we don't.[23] Randomization, however, requires the spouses to bind themselves to abide by the outcome of the coin toss.

IV. Conclusion

Dynamic models of strategic interactions between and among family members allow us to investigate possible inefficiencies in the lifetime allocation of resources within families. In non-unitary models of allocation within marriage, the equilibrium allocation typically depends upon the spouses' alternatives outside marriage (e.g., the "divorce threat") or their alternatives within marriage (e.g., "separate spheres"). Because investments that increase one partner's market earnings relative to those of his or her spouse will affect future bargaining power, strategic considerations will affect investment decisions.

Strategic marital inefficiencies are not limited to migration, but arise in a broad range of decisions that affect spouses' market earnings or other determinants of bargaining power. Three examples illustrate their generality.

* Individuals may overinvest in education ex ante to improve their bargaining position in subsequent family interactions. Using a two-stage model, Konrad and Lommerud [2000] demonstrate that family members who bargain cooperatively in the the

[23] "Must be" is too strong. The discussion should focus on the intersection of those segments of the frontier on which both spouses have strictly positive consumption.

second stage will overinvest in education in the first stage in an attempt to improve their bargaining positions. The resulting equilibrium is not a first-best optimum, and a simultaneous reduction in all education levels would be Pareto-improving.

* If children have asymmetric effects on the bargaining power of their mothers and fathers, then fertility decisions will have complex strategic implications, involving market earnings, the value of home production, and custody and support arrangements in case of divorce.

* Labor supply decisions, including market participation, job changes, and retirement, affect individual bargaining power as well as family resources. The timing of retirement may affect an individual's share of family consumption and, hence, may be affected by the anticipated loss of bargaining power when market earnings fall.[24]

The location decision of a married couple provides a very simple example of our basic assertion—that in a dynamic model of decision-making by a multi-person household, efficient solutions can be guaranteed only if household members are able to make binding commitments concerning future allocations. We show that, in the absence of a commitment mechanism that prevents a spouse advantaged by a move from renegotiating the intrahousehold distribution of resources, two kinds of inefficient outcome are possible: the couple stays in a location that is Pareto-dominated by some feasible post-move allocations, and the couple divorces so that one spouse can stay while the other moves. This result focuses our attention on mechanisms that may facilitate intertemporal commitments by family members, including social norms and up-front transfers, but suggests that the presumption that family decisions are efficient should not

[24] Lundberg, Startz, and Stillman [forthcoming] present evidence that the husband's relative power in the marriage does fall with retirement.

survive rejection of unitary family preferences.

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