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Strategic Labor Supply

A dynamic bargaining model and its econometric implementation

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Abstract

In this paper a dynamic bargaining model of intrafamily time allocation is presented with divorce as the threat point. Rational behavior leads to overinvestment in human capital and inefficient time allocation regarding housework and market work the latter of which is also supplied as an insurance against the risk of divorce. For married women in the German Socio-Economic Panel labor supply is estimated: A duration model on marital stability is performed to obtain predicted divorce probabilities. Then instrumental-variable estimation of female labor supply is performed with fitted wages and fitted threat points weighted by the individual probability of divorce. The empirical results support the bargaining argument of a strategic aspect to female labor supply.

Keywords: *time use, female labor supply, intrafamily bargaining, divorce, duration model, instrumental variable estimation*

JEL Classification: J22, C71, C35

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Introduction

Over the last four decades there has been an enormous increase in the labor force participation of married women. Whereas overall participation rates in Germany have been falling due to a reduction in life time work (later entry into the labor force as well as earlier retirement), married women's participation rates for age 25 to 50 almost doubled from the sixties to the late nineties, going from 37% to 70% (Franz 1996 and Statistisches Bundesamt 1997). Over the same period divorce rates have continuously increased. The probability of divorce in 25 years of marriage has tripled from 11% in 1955 to 29% in 1986 (Lengsfeld and Linke 1988). Whether the increasing risk of divorce is caused by higher female labor force participation, as many studies suggest, or whether married women now supply more labor due to the higher risk of divorce, as other studies argue (see for instance Diekmann (1994)), the decision to work certainly involves an aspect of insurance that has been missed by traditional models of household labor supply. It is this insurance aspect that will be incorporated in the theoretical modeling and econometric estimating of female labor supply in the present paper.

In the conventional common preference model (Becker 1965, Gronau 1973 and 1977) time allocation decisions of family members involve neither human capital considerations of job experience nor strategic bargaining aspects of individual control over financial resources. Instead individual labor supply is derived from the maximization of a household utility function subject to budget and time constraints. Apart from the fact that it still remains to be clarified just how such a joint utility function can be developed, whether it be a social welfare function of the sort proposed by Samuelson (1956), the utility function of an altruistic 'head of the household' as Becker suggested in 1974 or some other aggregation of the individual utility functions of all family members, the traditional framework fails to correctly explain the actual labor force participation of married women. In particular with regard to raising children women are often observed to work for much less than what could possibly be their value of home time when adjusting their labor supply until the wage rate equals the marginal product of housework equals the marginal rate of substitution between leisure and consumption.[1]

Part of the discrepancy between observation and traditional economic theory was taken up by Lehrer and Nerlove (1981). In their human capital model for labor supply and fertility behavior of married women, the life cycle is divided into three stages distinguished by the presence and age of children or, in other words, the demand for household production. A wife allocates her time among work in the labor force, work at home and leisure. She also decides about her investment in human capital which affects her wage rate in the subsequent periods. If the increase in future earnings is sufficiently large, she will work in the labor market even if her wage does not reach the shadow price of her time spent at home rearing kids.

Besides the maintenance of their human capital and the fear of foregoing future chances on the labor market after the child-rearing phase, many women state that they want to achieve some

[1] This is true esp. in light of the German tax system (Ehegattensplitting), which discourages market work by married women since women's earnings are hit by high marginal tax rates.

independence from their husbands' earnings[2]. Often this means working for a low wage rate. Strategic behavior and its distributional aspect of control over financial resources does seem to play some role in family decision making, though. Empirical studies (e.g. the survey by Diekmann and Klein, 1991) indicate that in the light of "fading family stability" and increasing divorce rates, labor force participation also serves as an insurance against the risk of divorce.

This strategic aspect of labor force participation was first taken into consideration by authors following a game theoretic approach. In their seminal works Manser and Brown (1980) and McElroy and Horney (1981) applied Nash cooperative bargaining theory to household decision making. In these models the distribution of utility within the household is determined by the feasible consumption set of the two partners and their outside options[3] which are the single-state utilities. Any change in the relative conflict payoffs, e.g. an increase in income of one of the partners, will affect the household utility distribution in that spouse's favor.

An alternative Nash bargaining model with non-cooperative marriage reflecting traditional gender roles instead of divorce as the outside option was proposed by Lundberg and Pollack (1993)[4]. The separate-spheres model, in contrast to the divorce-threat model, also explains different equilibrium distributions in existing marriages implied by transfer payments to either of the partners, even if these do not affect the single state utilities.

Ott (1992) takes account of intertemporal dependencies of household decisions in proposing a dynamic bargaining model with subgame consistency. In this setting the partners' outside options are not given exogenously any more, instead they are endogenously determined by the preceding period's time allocation. An individual's decision to supply labor is made allowing for the accompanying impact on her future conflict payoff. The partners' relative bargaining powers therefore directly depend on past time use decisions and the resulting human capital accumulation. Sequential non-cooperation does not allow to sign binding contracts between the periods. This framework seems to be most appropriate for explaining the labor force participation of many women who not only consider actual labor income but also the human capital aspect of job experience as well as their future bargaining power within the household when making time allocation decisions.

This paper is divided into two parts: In the theoretical part a dynamic bargaining model of family labor supply is discussed, in the empirical second part the implications of the theoretical model are incorporated into an econometric estimation of female labor supply.

In the following section I propose a dynamic bargaining model that extends the work of Ott (1992). Time allocation is determined by intrafamily bargaining taking place within a three-period life cycle. Whereas in the first stage human capital investments are made non-cooperatively by each individual, in the subsequent stages, i.e. the family phase, time allocation decisions (esp. time devoted to housework as opposed to time spent in the labor market) are determined through Nash bargaining between the partners with separation as their threat point. In this model rational individuals not only tend to overinvest in human capital during the first period of life but also have an incentive to choose suboptimal time patterns at the beginning of the family phase should this improve their bargaining position in the following period. This result is due to an asymmetry of the learning effects from market work versus housework and to the asymmetry of the marketability of the different labor skills. Unless binding long-term contracts can be made between the partners, rational behavior always leads to inefficient

[2] See e.g. Gaugler (1984).

[3] The terms outside option, threat point and conflict payoff are used synonymously. They all indicate a person's best alternative to the bargaining outcome.

[4] Woolley (1988) as well as Konrad and Lommerud (1996) also model intrafamily decision making as a Nash bargaining model with internal threat points.

outcomes with respect to time allocation and household production within the family. Extending the traditional framework, in this model labor supply decisions are also determined by strategic bargaining considerations.

In the econometric part of the paper these strategic aspects are taken into account when estimating female labor supply in a five-stage procedure using data from the German Socio-economic Panel. First the data set is introduced and a comparison of sample characteristics by incidence of future divorce is presented. The apparent interdependence between participation and marital stability suggests that labor supply might in fact be caused by the individual risk of divorce. The five-stage procedure is carried out for a model specification with 'virtual conflict payoffs'. A loglinear duration model on marital "survival" or stability is estimated. The resulting conditional probabilities of divorce serve as weights for the conflict payoffs obtained from subsample OLS conflict payoff equation estimates. The resulting expected conflict payoffs is entered as an instrumental variable into the probit estimation of labor force participation and into the OLS estimation of female hours worked. With the explicit inclusion of the individual outside option the resulting labor supply equation takes into consideration strategic aspects of intrafamily time allocation.

The paper concludes with a summary of the theoretical and empirical results from analyzing labor supply within a dynamic bargaining framework.

I A three-period bargaining model

I consider a model[5] in which an individual's life cycle is divided into three periods of differing length: In the first period decisions on human capital investment are made, that is, the available time has to be allocated among education activities *K* and leisure *L*. At the beginning of the second period each individual is randomly matched to a partner with whom she forms a family in order to raise children[6]. In the second and the third period the family phase, time is allocated among three competing activities: work in the labor force *M*, which yields market goods, work at home *H*, which yields home produced goods such as child services, and leisure *L* which yields direct utility. The two periods are distinguished by the children's age or their demand for care (i.e. household production), respectively. This takes a high value in period 2 when infants have to be looked after 24 hours a day and, from a certain age on, diminishes steadily in the late family phase.[7] Whereas in the first period time allocation and consumption decisions are made independently by each individual, the family phase is characterized by a two-stage cooperative Nash bargaining game: the distribution of leisure and consumption goods within the household is, according to the axiomatic Nash solution of the game, determined by the maximum product of the individual cooperation gains in the two stages. Agreements made at the beginning of the family phase are only binding for one period. Human capital accumulation in one period does not take effect until the subsequent period. Hence, the outside options and the payoff space in the second and third period are determined by decisions made in the prevailing pre-period. Although the utility function is intertemporally separable, the life periods are nonetheless interrelated through the determination of the conflict payoffs. Because of this interdependence the three-stage optimization problem has to be solved through backwards induction according to the idea of subgame consistency.

The optimization problem of spouse *a* is illustrated with the following picture:

life cycle: $U_1^a + U_2^a + U_3^a \rightarrow \left(U_2^a + U_3^a - C_2^a\right)\left(U_2^b + U_3^b - C_2^b\right) \rightarrow \left(U_3^a - C_3^a\right)\left(U_3^b - C_3^b\right)$

time use:

K, L_1	M_2, H_2, L_2	M_3, H_3, L_3

backwards induction: $U_1^a + W^a \leftarrow \left(U_2^a + V^a - C^a\right)\left(U_2^b + V^b - C^b\right) \leftarrow \left(U_3^a - C_3^a\right)\left(U_3^b - C_3^b\right)$

[5] The model proposed extends the work of Ott (1992, 1995) by taking into account pre-family human capital decisions.

[6] In this model the term 'family' generally describes a household in which two persons mutually agree on living together and where a substantial amount of household 'jobs' have to be taken care of. These jobs do not necessarily have to be linked to the bearing and rearing of children, they could also include the nursing of relatives in need of care.

[7] The exact age of distinction between stage 2 and stage 3 depends on the institutional circumstances regarding the amount of child care services provided by schools e.g.. In Germany families with children reaching school age certainly do not enter the third stage as this means even less institutionally provided child care than in kindergarten; here, the distinguishing age level has to be assumed much higher.

where U_t^a and U_t^b are individual utility functions depending on the level of private consumption and the amount of leisure and V_t^a, V_t^b, W^a and W^b are so-called 'maximum-Nash-solution functions' of the partners a and b at time t. C^a and C^b are the corresponding conflict payoffs. The conflict payoff as the solution to the maximization of single-state utility represents the maximum utility that could be achieved outside the partnership[8], in other words, it reflects the opportunity costs of family life that are determined by the spouse's productivity factors, such as wage rate, household productivity, and non-labor income.

The solution to the three-period model is derived recursively as follows:

Period 3: $max \quad \left(U_3^a - C_3^a\right)\left(U_3^b - C_3^b\right)$

Period 2: $max \quad \left(U_2^a + V^a - C^a\right)\left(U_2^b + V^b - C^b\right)$

Period 1: $max \quad U_1^i + W^i \qquad \text{for } i = a, b$

First, the conditional bargaining solution for period 3 will yield 'maximum-Nash-solution functions' V^a and V^b which depend on time allocation decisions made in the preceding period. Using these indirect utility functions the decision problem of the second period will be solved, again providing 'maximum-Nash-solution functions' W^i for this period. The same procedure is then repeated for the first period.

Period 3

$$max \quad N_3 = \left(U_3^a\left(X_3^a, L_3^a\right) - C_3^a\right)\left(U_3^b\left(X_3^b, L_3^b\right) - C_3^b\right)$$
$$= \left(U^a - C^a\right)\left(U^b - C^b\right)$$

$$\textit{where} \qquad X^a + X^b = X = X_M + X_H \quad \text{and} \quad X_H = Z\left(H^a + H^b\right)$$

$$\textit{s.t.} \qquad T = M^i + H^i + L^i \quad \text{for} \quad i = a, b$$

$$\textit{and} \qquad w^a M^a + w^b M^b - X^a - X^b + Z\left(H^a + H^b\right) + I^a + I^b \geq 0$$

In this last period a static Nash-bargaining game has to be solved. The product of the individual cooperation gains is maximized with regard to private consumption X^i and leisure L^i, subject to budget and time constraints. The private consumption goods of the two partners can either be produced at home $\left(X_H\right)$ according to the household production function Z or purchased on the market. The total amount of market goods X_M must not exceed pooled household income generated by labor income $w^a M^a + w^b M^b$ plus non-labor income $I^a + I^b$.[9]

Optimal time allocation in this static setting is known from traditional results, i.e. in equilibrium time is allocated among market work and household production according to the equality

[8] It is assumed that such important decisions concerning labor force participation and home work justify the use of the divorce-threat model as opposed to fall backs with non-cooperative behavior (see discussion in the introduction).

[9] The price of the market good is set to unity.

between the prevailing productivity factors w^i and z^i (with $z^i = \frac{\partial Z}{\partial H^i}$) and the marginal utility of leisure relative to that of consumption:

$$\frac{U_L^i}{U_X^i} = z^i = w^i$$

As in the Beckerian framework different wages for men and women lead to specialization of the partners according to their comparative advantages.

The main distinction between this static bargaining model and the traditional model lies in the distribution of utility within the family. Whereas in the common preference theory the question of intrafamily distribution is simply not addressed, here it is conditioned on the relative bargaining positions of the partners. Thus, a rise in a's conflict payoff, e.g. due to an increase in this spouse's non-labor income, results in an intrafamily redistribution favoring *a*.

$$\frac{U_X^a}{U_X^b} = \frac{U^a - C^a}{U^b - C^b}$$

and

$$\frac{U_L^a}{U_L^b} = \frac{w^a}{w^b}\left(\frac{U^a - C^a}{U^b - C^b}\right) = \frac{z^a}{z^b}\left(\frac{U^a - C^a}{U^b - C^b}\right)$$

Period 2

The optimization problem of the second period is solved using the 'maximum-Nash-solution functions' $U_{N3}^{a*} = U_3^a\left(X_3^{a*}, L_3^{a*}\right)$ and $U_{N3}^{b*} = U_3^b\left(X_3^{b*}, L_3^{b*}\right)$ from the bargaining game above. With $U_{N3}^{a*} = V^i\left(w_3^a, w_3^b, z_3^a, z_3^b, I_3^a, I_3^b\right) = V^i\left(M_2^a, M_2^b, C^a\left(M_2^a\right), C^b\left(M_2^b\right)\right)$, V^i is determined by time allocation decisions made in period 2. Second period's time allocation is then optimized according to:

$$\begin{aligned} max \quad N &= \left(U_2^a + U_3^a - C^a\right)\left(U_2^b + U_3^b - C^b\right) \\ &= \left(U^a + V^a - C^a\right)\left(U^b + V^b - C^b\right) \end{aligned}$$

s.t. budget and time constraints as above.

For the optimal level of M_2^a the following condition must be satisfied:

$$\frac{U_L^a}{U_X^a} = z^a = w^a + \frac{1}{U_X^a}\left(\frac{\partial V^a}{\partial M_2^a} + \frac{\partial V^a}{\partial C^a}\frac{dC^a}{M_2^a}\right) + \frac{1}{U_X^b}\left(\frac{\partial V^b}{\partial M_2^a} + \frac{\partial V^b}{\partial C^a}\frac{dC^a}{M_2^a}\right) \qquad (1)$$

If equality holds, time will be allocated among market work, work at home and leisure according to the marginal outputs of these time uses[10]. In contrast to the traditional

[10] For simplicity the marginal benefit of household work is restricted to the actual household productivity z while paid labor also yields human capital effects. A consideration of human capital accumulation in household production, however, would not alter the results qualitatively as long as the human capital gained from specialization in the household is less marketable than the human capital accumulated in market work.

framework, here, the marginal output of labor is not restricted to the hourly wage rate but also includes the impact of current labor force participation on next period's utility.

If the individual wage rate is positively related to the human capital accumulated, hence a function of the form $w_t = w\left(K, \sum_{t=1}^{t-1} L_t\right)$ with $\frac{\partial w}{\partial K} > 0$, $\frac{\partial^2 w}{\partial^2 K} < 0$, $\frac{\partial w}{\partial L_t} > 0$ and $\frac{\partial^2 w}{\partial^2 L_t} < 0$, the decision to work will have different long-run effects: Due to a higher wage level an enlargement of the feasible consumption set, that is an outward shift of the utility possibility frontier, will result. I call this the pure frontier effect. At the same time a change of the conflict payoff will lead to a distributional bargaining effect. Both frontier effect and distributional bargaining effect arise from the impact of market work on own future utility and spouse's future utility weighted by the respective marginal utilities of consumption $\frac{1}{U_X^a}$ and $\frac{1}{U_X^b}$, respectively. Since time spent in the labor market typically has the described positive impact on future utility through a shift of the utility possibility frontier or an improved bargaining position, time is allocated to market work even at a wage rate much below household productivity. Hence, in comparison with traditional theory relatively more time will be dedicated to market work and less to household production. (Even at $z = w$ a specialization in market work takes place.) This is due to the asymmetry between the accompanying learning effects resulting from the lower marketability of household abilities. Or, in other words, the differing effects from investments in market-specific human capital and investments in family-specific human capital on bargaining power counter-effect the advantages of specialization.

Considering the long-run effects of time use, i.e. the marginal output of time spent in market production as opposed to time spent in household production, even different wage structures of men and women do not necessarily lead to complete specialization as would be the case in traditional theory. Instead, the interior solution of both partner's time being allocated to all different time uses, to paid as well as unpaid work in particular, that one observes in reality can now be explained.

Labor supply can be described as a function of both spouses' wages, household productivities, nonlabor income and conflict payoffs:

$$M_2^i = M^i\left(w^a, w^b, z^a, z^b, V^a, V^b, C^a, C^b\right).$$

Period 1

The optimization problem of the first period is solved using the 'maximum-Nash-solution functions' $U_{N2}^{a*} = U_{a2}\left(X_2^{a*}, L_2^{a*}\right)$ and $U_{N2}^{b*} = U_{b2}\left(X_2^{b*}, L_2^{b*}\right)$ from the bargaining game above. With $U_{N2}^{a*} = W^i\left(w_2^a, w_2^b, z_2^a, z_3^b, I_2^a, I_2^b\right) = W^i\left(K^a, K^b, C^a\left(K^a\right), C^b\left(K^b\right)\right)$, W^i is determined by time allocation decisions made in period 2. Now, first period's time use is optimized according to:

$$\begin{aligned} max \quad & U_1^i + U_2^i + U_3^i \\ & = U^i + W^i \\ s.t. \quad & T = M^i + K^i + L^i \\ and \quad & w^i M^i + I^i - X^i \geq 0 \quad for \quad i = a, b \end{aligned}$$

Since in the pre-family stage decisions on time use are made independently, individual maximization is now subject to individual budget constraints.

Optimal time allocation decisions have to meet the first order condition:

$$\frac{U_L^i}{U_X^i} = \frac{1}{U_X^i}\left(\frac{\P W^i}{\P K^i} + \frac{\P W^i}{\P C^i}\frac{dC^i}{dK^i}\right) \tag{2}$$

The amount of educational investment should be chosen so as to equalize the shadow price of time and the marginal benefit associated with an additional unit of schooling. Since human capital investment takes effect on future wage rates, the marginal output of education has two components: The first is the direct impact of education on utility possibilities, the frontier effect, the second is the distributional bargaining effect that arises from a change of the individual conflict payoff. More human capital leads to higher returns from market work and thus improves the financial situation of the household as a whole. At the same time it strengthens the individual bargaining power through an improvement of the single state utility. Due to these long-run effects of time use more human capital investment will typically result in comparison with traditional theory or even compared with the dynamic model of Lehrer/Nerlove which explicitly considers human capital accumulation.

Implications

Since in the family phase the distribution of utility within the household is uniquely determined by the utility possibility frontier of the two partners as well as their outside options, all decisions that affect these parameters are of great importance for the intrafamily allocation of time. The amount of human capital investment chosen by each individual in the first period of life will set the basis for the family bargaining game in the following periods with regard to the origin of the feasible payoff space and the conflict payoff. Likewise, intrafamily time allocation in the second period has implications not only for that period's outcome but also decides about the partner's bargaining positions in the late family phase (3rd period).

Pre-family human capital investment

There are two effects resulting from any change in human capital investment: a shift of the utility possibility frontier and an altered division of resources between the partners. Starting from a given optimal education level, i.e. for efficient choices in the pre-family stage, the frontier effect of an extra unit of schooling (in equation 2) has to be zero. The distributional bargaining effect, however, induces a move along the efficiency frontier favoring a so that a has an incentive to overinvest in human capital compared to the household-efficient level K^{a*}. Overinvestment occurs as long as

$$\frac{dC^a}{dK^a} > \frac{\partial U^a}{\partial L^a},$$

that is, as long as, by accumulating an extra unit of human capital exceeding the efficient level, the improvement of a's bargaining position is higher than her utility loss from reduced leisure

time in period 1. This condition holds if optimal human capital investment as single is higher than within a family[11].

In traditional models no incentive for overinvestment exists. Since the outside option is neglected, the total effect of an extra unit of education would be zero. The traditional result could therefore be considered as a special case of the bargaining approach where optimal human capital investment as single equals that within a family. Hence, education exceeding the optimal level would have no effect on the individual bargaining position. This would also be true for a setting with binding long-term contracts between the partners, where the individual bargaining powers are assumed to remain unchanged regardless of educational decisions. Thus the lack of distributional incentives would sustain an optimal level of human capital investment.

As opposed to the human capital model by Lehrer and Nerlove (1981) where the optimal level of investment in human capital is a function of the extent to which this capital is utilized in the subsequent stages of life, here the human capital endowment serves for improving the individual bargaining position regardless of its actual utilization. In other words, the human capital endowment is employed rather implicitly than explicitly in the time allocation decision. It serves as a strategic variable for determining intrafamily distribution.

Intrafamily labor supply

Rational individuals not only tend to overinvest in human capital at the pre-family stage but also have an incentive to choose suboptimal time patterns at the beginning of the family phase if this will improve their bargaining position in the following period. Again, there are two effects arising from a change in second period's labor supply on the bargaining set of the late family phase: a shift of the utility possibility frontier and an altered division of resources between the spouses. Since for efficient choices the frontier effect equals zero, an additional unit spent in the labor force does not change the utility space but induces a move on the efficiency frontier towards a higher utility level for a. As we can see from equation (1) an oversupply of market work in the second period will occur if, starting from given optimal time allocation, an increase of one partner's labor force participation will raise her next-period's conflict payoff (i) and if the distributional bargaining effect favoring her own future utility exceeds that of her spouse's (ii):

$$\text{(i)} \qquad \frac{\partial C_2^a}{\partial M_2^a} > 0$$

$$\text{(ii)} \qquad \left| \frac{1}{\partial U_X^a} \frac{\partial V^a}{\partial C_3^a} \right| > \left| \frac{1}{\partial U_X^b} \frac{\partial V^b}{\partial C_3^a} \right|$$

The first condition holds if optimal labor supply as single is higher than within a family. In the traditional framework no incentive for oversupply exists. Since the outside option is neglected, the total effect of an extra unit of market work would be zero. The traditional result could therefore be considered as a special case of the bargaining approach where optimal time allocation as single equals that within a family. Hence, labor supply exceeding the optimal level would have no effect on the individual bargaining position. This would also be the case in a setting with binding long-term contracts between the partners, where the individual bargaining powers are assumed to remain unchanged regardless of the chosen time uses in period 2. Thus

[11] This implication corresponds with the results of Konrad and Lommerud's two-stage game of marriage (1996) where the wage rate is chosen non-cooperatively in the first stage and a Nash bargaining game between the partners is solved in the second stage.

the lack of distributional incentives would sustain an optimal level of labor supply. Unless binding long-term contracts can be made between the partners bargaining outcomes will be suboptimal with respect to time allocation and household production[12]. Due to intrafamily bargaining, individual optimization is not exclusively focussed on the maximization of family outcome but also one's own share of that outcome. Since utility within a household is distributed according to the partner's external alternatives, time allocation decisions have to be made in the light of their effects on these external alternatives. Even though with the presence of small children in the early family phase more time devoted to household production, particularly a specialization of the partners, would be efficient in the short run, none of the partners will be willing to weaken her future bargaining position. As a result, not all production possibilities in the household can be exhausted. On account of educational overinvestment before and suboptimal time allocation within the early family phase the gains from specialization within the household will be less those technically feasible. In the dynamic bargaining model with endogenously determined conflict payoffs paid labor serves as a strategic variable for intrafamily utility distribution.

Discussion of the theoretical results

In the model presented rational individuals tend to overinvest in human capital in the pre-family period. At the beginning of the family phase they also have an incentive to choose an amount of labor supply exceeding the optimal level or an amount of household production falling short of the optimal level, respectively, should this improve their bargaining position in the following period. Unless binding long-term contracts can be made between the partners, rational behavior always leads to inefficient outcomes with respect to time allocation and household production within the family.

One major implication of intrafamily bargaining concerns the estimation of labor supply. For the reasons just described, the decision to participate in the labor market in the dynamic bargaining approach is not only determined by productivity indicators, such as wage rates and household productivities, but also includes human capital accumulation as well as strategic aspects regarding the individual bargaining position. A consideration of these strategic aspects in econometric specification will therefore lead to more adequate estimations of individual labor supply.

With its assumption about the time structure of life this model describes an extreme case of family formation. Human capital investments are made before partners in life meet randomly and start bearing and rearing children. Another extreme case of lifestyle would be the single state. Reality must lie somewhere in between these two cases. If a probability is assigned to each extreme, then an individual's expected lifetime utility takes some value weighted by the likeliness of these two lifestyles. As for the investment in education, if the probability of staying single is greater than zero and if the sufficient conditions for overinvestment hold, i.e. optimal human capital investments as single are higher than within marriage, even greater overinvestment will result. This is because no one can be sure that he or she will meet "Mrs. or Mr. Right" and be able to take advantage from a cooperation surplus, esp. that share generated by intrahousehold specialization. Thus, the finding of inefficient educational decisions stays, even in a more general version of this model.

II Empirical evidence of the dynamic bargaining model

[12] On a discussion concerning the enforcement of intrafamily agreements see Ott (1993).

In this section the strategic aspect of family time use decisions that has been derived theoretically is implemented in an estimation of female labor supply, taking into account marital stability and the outside option to marriage as determinants of female labor force participation[13].

A number of studies investigated how divorce probabilities influence female labor supply decisions (Peters 1986, Haurin 1989, Parkman 1992, Johnson and Skinner 1992, Bolin 1997, Butrica 1998, Gray 1998). William R. Johnson and Jonathan Skinner (1986) accounted for the effect of marital stability on labor force participation in estimating a simultaneous model of future divorce probability and current labor supply for married women. Using 1972 data from the Panel Study of Income Dynamics (PSID) for couples who were married in that year and some of whom separated partially in the following 6 years, their results support the hypothesis that subjective divorce probabilities increase labor supply. In a cross-national comparison Barbara Butrica (1998) finds large differences between the United States and Germany. Her estimations, based on the 1986 samples of the PSID and the German Socio-Economic Panel (GSOEP), suggest that the probability of divorce has no significant impact on labor supply or hours decisions of women in the U.S. whereas Germany very much resembles the U.S. in the 1970s. Kristian Bolin (1996) adopted a similar approach with Swedish data. He also included the risk of divorce as an additional regressor in the labor supply equation. Whereas Johnson/Skinner and Butrica estimated labor supply within marriage, Bolin was interested in labor supply at the time of marriage. His results also convey a significant impact of predicted divorce risks on female labor force participation.

Using 1979 U.S.-data the articles by H. Elizabeth Peters and by Allen M. Parkman both conclude that the introduction of unilateral divorce has increased the labor force participation rate of married women. But whereas Peters attributes this response to the lack of compensation for marriage-specific investment at divorce that creates an incentive for married women to enter the labor force and increase their marketable capital, Parkman argues with the lack of compensation for married women's reduced human capital. He finds a greater effect of unilateral divorce on the labor supply of younger and better educated women who could experience larger reductions in their future earning capacity if they reduced their participation in the labor force. Although Parkman implicitly considers the dynamic effects of human capital depreciation for married women, overall the cited studies restrict their analysis to the relationship between labor supply and the risk of divorce as such rather than the impact of the external alternative or outside option to family decision making, i.e. the impact of the underlying bargaining power.

Jeffrey S. Gray accounts for the relevance of the wife's bargaining position when investigating U.S. married women's labor supply behavior with a change in marital property laws. Since a state's adaption of unilateral divorce can be interpreted as an exogenous and unexpected shift of the extrahousehold environmental parameters (EEPs) of family life. In contrast to Peters and Parkman he finds that unilateral divorce as opposed to mutual-consent divorce has no impact on married women's labor force participation unless the underlying marital-property laws in each state are considered (1998: 629). By analyzing exogenous changes of EEPs Gray concludes that the wife's labor supply is an increasing function of her bargaining position within marriage.

[13] Theoretically, male labor supply is just the same subject to these strategic considerations. Practically, however, men's hours worked show much less variation than women's. Since the model proposed has in any case initially been chosen to motivate the observation of married mothers' labor force participation, the analysis will be restricted to women only.

In the present paper the empirical application of bargaining power in family decison making is even further developed: Women's outside options are estimated and their impact on female labor supply are investigated to directly test the theoretical relationship derived in the dynamic bargaining model above, thereby applying the concept of the 'virtual conflict payoff'.

The virtual conflict payoff

The concept of the 'virtual conflict payoff' accounts for the endogeneity of individual bargaining power on individual time allocation, particularly labor force participation. It proceeds from the fact that everybody has an outside option to family bargaining regardless whether it will ever be realized or not. Whereas for separating couples we are able to observe their economic performance after break-up and, thus, a realization of their outside option to staying with their spouses, for intact partnerships we do not know the conflict payoffs. This is where the 'virtual' comes into play: Why not apply whatever can be observed with separating spouses to the non-separating ones in order to generate a 'virtual conflict payoff' for every single person no matter whether a household dissolution has actually taken place? The impact of the virtual or expected conflict payoff on individual time allocation can then be examined. In other words, the strategic aspects of supplying labor that have been derived in the theoretical model are now investigated empirically. Allowing for human capital and other individual endowment factors, the individual outside option is chosen as an additional determinant for the supply of labor. This extends the conventional estimation of female labor supply by a strategic element[14].

Data set and sample characteristics

To explore the relationship between female labor supply and marital stability in Germany I use data from the German Socio-Economic Panel (GSOEP)[15]. As an individual household microdata panel the GSOEP is a rich data source for analyzing labor force participation by means of various individual as well as household characteristics. The empirical results are based on data from the West German subsample of the GSOEP covering the years from 1985 to 1997. Making use of the panel structure of the data the longterm impact of the risk of divorce on current labor supply has been accounted for: a cross-section sample of couples that were married in 1985 (2nd wave of the GSOEP) has been analyzed having additional information on their marital status as well as their economic status in the twelve subsequent years until 1997. The analysis is restricted to couples with the wife not younger than 20 and not older than 45 years of age as well as to couples where both spouses have completed their schooling in 1985, in order to cover time allocation decisions made in the early family phase when (according to the theoretical model) human capital investments in education have already been done. The final sample consists of 538 couples, 442 of whom remained married during the following 12-year period and 96 of whom separated or divorced in one of the subsequent years[16].

[14] The simultaneous modeling of time allocation decisions and household dissolution characterizes an extension of the conventional estimation procedures for female labor supply (for an overview of the empirical literature see e.g. Layard et al. 1980, Killingsworth 1983, Killingsworth and James J. Heckman 1986, Mroz 1987).

[15] For more information on the GSOEP see Wagner et al. (1993).

[16] The sample is not limited to "complete" couples, though. In other words it partly consists of women whose husbands have left the panel at some stage and it includes men whose wives did not participate in the interviews during the whole time period. To be precise, information on 442 women living in stable marriages and 96 separating women is being used together with the observations of 416 non-separating and 83 separating men.

In Table X (NOT DISPLAYED IN THIS VERSION) the summary statistics of the two sub samples, based on women with high marital stability and based on separating women, are listed. The two samples reveal great differences in their human capital endowment, their current labor force participation and in personal characteristics as regards marital and cultural backgrounds. The average non-separating couple is older than a separating couple. It got married at a younger age and has been married for a longer time. Also the share of first marriages is substantially higher with stable partnerships. Non-separating women are on average less educated (i.e. less years of schooling), have less full-time work experience in full-time employment, their labor force participation and monthly work hours are lower than those of divorcing women. Their husbands, on the contrary, have more work experience and are currently working to a higher extent than in separating couples.

Overall we can say that gender differences with regard to human capital endowment and labor force status are smaller among separating couples. Female and male education, work experiences, current labor force participation and hours of work are all more equated in the separating subgroup. Even the age difference between husband and wife is greater with non-separating spouses. These complementarities within 'stable' couples might be an indication for the Beckerian argument of comparative advantages. That is, with diminishing gender differences the returns from specialization within the household are loosing importance. For the separating sub sample the gains from staying married are (or have been) lower.

Five-stage estimation: The generalized Heckman procedure with virtual conflict-payoffs

The labor supply of married women will be estimated according to the following equation:

$$h_i = b_1 \cdot X_{1i} + g \cdot w_i^* + h \cdot bpow_i^* + e_{1i}\, i = 1,..,N$$

$$w_i^* = b_2 \cdot X_{2i} + e_{2i} \qquad i = 1, \ldots, N$$

where X_{1i} is a vector of variables commonly used as regressors in an estimation of labor supply (education, age, previous work experience, children, household nonlabor income, husband's earnings). w_i* is the wife's own (latent) wage rate and $bpow_i$* is an indicator of relative bargaining power consisting of the couple's expected (latent) individual conflict payoffs. The effects of omitted variables are represented by the random error term e_{1i}.

In order to consider the outside option in the labor supply equation expected conflict payoffs have to be generated for those spouses who did not separate within the sample period and hence do not yield any information on their fall back position explicitly. Consider a payoff equation for the latent conflict payoff c_i* of the form

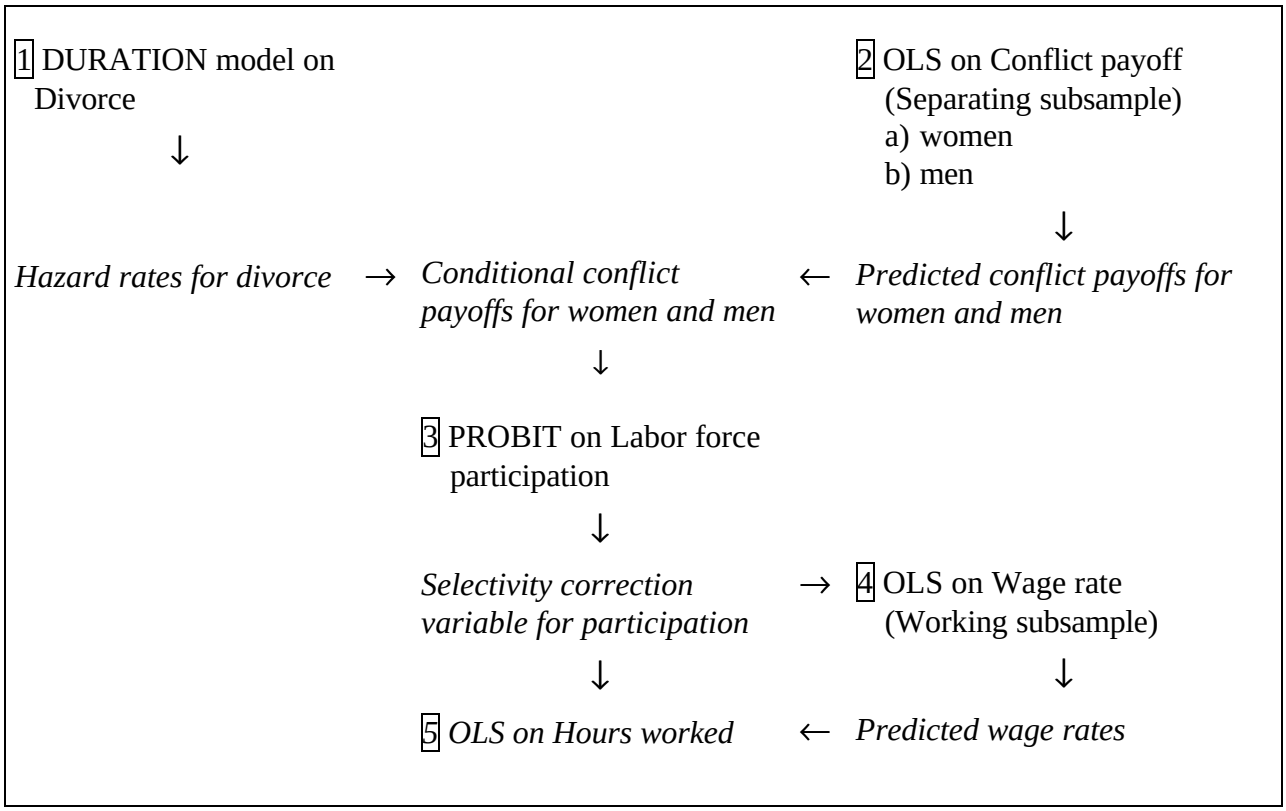
$$c_i^* = t \cdot Z_i + e_{ci} \qquad i = 1, \ldots, N$$

where Z_i is a vector of variables observed for all divorced men and women, including e.g. the tenure of marriage, age at marriage, human capital and other socio-demographic variables, and ε_{ci} is a mean zero normally distributed random error term representing the effects of unobserved factors such as emotions. Since c_i* is only known for the separating subgroup (d=1) one observes:

$$c_i = c_i^* \qquad if\ d = 1$$
$$c_i = 0 \qquad if\ d = 0$$

The problem of sample selection bias has to be carefully considered when assigning conflict payoffs to non-separating wives and husbands since the group of separated respondents might differ from the group of still married spouses on account of unobserved variables. Otherwise the use of predicted conflict payoffs obtained from an OLS estimation based on separating respondents only might result in inconsistent parameter estimates due to sample selectivity problems. Therefore, the Heckman procedure for selectivity bias-corrected estimations (Heckman 1979, 1980) should not only be applied to the estimation of the wage rate but to the determination of consistent conflict payoffs as well. When applying the two-stage Heckman procedure to the estimation of conflict payoffs, however, no robust estimation results could be obtained due to collinearity problems and the very small sample size of separating couples (n=94). As simulation studies showed (Puhani 1997, Rendtel 1992), in those cases subsample OLS still proofs to be the most robust estimator. As a consequence, we estimate conflict payoffs using the subsample of separating couples only. Virtual conflict payoffs are then predicted for the whole sample according to their socio-demographic characteristics.

Figure 1: Five-stage estimation procedure



The five-stage estimation procedure is performed as displayed in Figure 1: In the first stage a loglinear duration model (Weibull model) on marital "survival" or stability is estimated for the full sample in order to later compute conflict payoffs conditional on the tenure of marriage. The resulting hazard rates yield conditional probabilities of divorce for each individual for each year of their remaining (average) lifetime. Second, male and female OLS conflict payoff

equations are estimated using the separating sub-sample only. Together with the hazards expected cumulative conflict payoffs are computed for all men and women. These predicted conflict payoffs are in the third step entered as an instrumental variable into the probit estimation of labor force participation. From the probit estimates the inverse Mills ratio λ_l of participation is computed and added to the OLS wage equation for workers only. Fitted values for wage rates derived from the selectivity bias-corrected wage equation estimates (stage 4) together with the predicted conflict payoffs are included in the fifth and final step: an OLS regression on labor supply, again based on the restricted sample of employed women only. Thus the final labor supply estimation uses two instrumental variables, the virtual wage rate and the virtual conflict payoff.[17]

The conflict payoff measure

In the theoretical model presented above family partners bargain over the distribution of utility according to their relative bargaining powers. But how is this bargaining power determined empirically, in every day life so to speak? Assumably there is nobody explicitly computing his or her conflict payoff that would be realized in case of a divorce. In an implicit way, however, every person comes across conflict payoff measures when observing friends, relatives or neighbors who separate. I argue that each individual applies this bargaining measure, at least subconsciously, to her own situation, given the individual human capital endowment, household characteristics and EEPs. In other words, it is the perceived bargaining power drawn from personal observations and expectations that affects intrafamily decision making.

The conflict payoff actually drawn from the separating group is computed as the monthly equivalized income in the second year after break-up according to $inc_e = \frac{hhinc}{(hhsize)^{0.5}}$. Hence, household income is divided by the square root of the number of household members to consider economies of scale in household consumption. Since during the twelve months following a separation entitlements to transfer payments have in most cases not been settled yet, reported income turns out to be subject to heavy changes. Therefore I decided to use the second year's financial status (after separation) as a more robust measure of an individual's conflict payoff[18].

Once the payoff estimation coefficients have been obtained, virtual conflict payoffs can be predicted for the whole sample and for every subsequent year, based on the respondents socio-demographic characteristics. Those characteristics that are strictly monotonically increasing over time (such as all age variables) are perpetuated, whereas behavioral variables such as that portion of mariage life that has been spent in gainful employment are set constant. The final conflict payoff measure is then computed as the weighted average of expected future conflict payoffs, with the weights according to individual divorce probabilities in all years.

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[17] For the wage equation age, age squared, years of schooling (plain and squared) and previous work experience in full-time and in part-time jobs (plain and squared) are used as explanatory variables:

$$w_f = 0.225age - 0.003age^2 - 2.31edu + 0.139edu^2 + 0.311fullex - 0.009fullex^2 - 0.041partex + 0.009partex^2 + 0.408l_l$$

with R^2 of 0.51. A selectivity-bias correction (λ_l) is performed for the wage equation.

[18] It could be argued that a woman's individual income rather than her share of the household income represents her conflict payoff in case of a divorce. On the other hand, the measure used should account for the possibility of a new partnership and the accommodating financial resources which, after all, are part of the EEPs.

The bargaining power indicator

Bargaining power as a determinant of the strategic supply of labor can be included into the estimation equation in different ways. In the theoretical model it is the relative bargaining coefficient, reflected by one partners gain from bargaining divided by that of the other spouse, which conditions the individual time use decision. In the empirical analysis I therefore also use a relative measure of individual bargaining power, namely the deviation from symmetry in bargaining positions[19]. The symmetry indicator is formed as a function of the spouses' conflict payoffs: $sym = \left(\frac{c_i}{c_j} - 1 \right)^2$, with c_i being the lower payoff. The indicator is zero for spouses with equal outside options, i.e. equal bargaining positions, and it is higher the more one partner's outside option exceeds that of the other.

(Preliminary) Estimation results

A nested Probit estimation of female labor force participation (see Table 3 in the Appendix) reveals that the decision to work is positively related to the absolute size of the wife's expected conflict payoff and negatively related to the symmetric bargaining indicator even when controlling for variables indicating her own and her husband's human capital, the opportunity costs of market work (measured by the presence of children) and non-labor income. This result indicates that female labor supply can be partly led back to strategic considerations regarding the individual future bargaining position. The more equal the couples' bargaining powers the higher is the woman's incentive to maintain this relative bargaining position. The expected relative attractiveness of a woman's external alternative with respect to that of her partner significantly determines her labor force participation. Including these payoff measures leads to a better fit of the model (the value of the log likelihood function decreases from –244 to –226).

The number of hours worked by a female, estimated in stage 5, is also positively related to her absolute conflict payoff (Table 4). The higher her expected outside option the more hours she works (for strategic reasons). The deviation from a symmetric future bargaining situation between the spouses, however, does not significantly matter for her decision to participate in the labor market. One way to understand this result is to see participating in the labor market, no matter to which extent, as an implicit option for economic independence from the partner. By staying in the labor force married women try to keep their human capital and hence their relative bargaining power from depreciating. To have the foot in the door (that is to say: in the labor market) and not to be able to make their own living is what mainly drives married women to supply labor. Overall the estimation results support the bargaining argument that there is also a strategic aspect to women participating in the labor market.

Conclusions

In the theoretical model presented rational individuals tend to overinvest in human capital in the pre-family period. At the beginning of the family phase they have an incentive to choose an amount of labor supply exceeding the optimal level or an amount of household production falling short of the optimal level, respectively, should this improve their bargaining position in the following period. Unless binding long-term contracts can be made between the partners, rational behavior always leads to inefficient outcomes with respect to time allocation and

[19] The symmetry indicator has been used by Ott (1992) for the spouses' wage ratio in an estimation on the practice of birth control.

household production within the family. Since the model takes into account the dynamic implications of different time uses labor is also supplied out of strategic reasons. It serves as an insurance against the risk of divorce.

The empirical results in this paper show that, according to the theoretical model, a woman's relative bargaining power, measured as the deviation from symmetry between her own and her husband's virtual conflict payoffs, is negatively related to her labor force participation and the size of her conflict payoff is positively related to the number of hours worked. It seems that by staying in the labor market married women intend to keep their human capital and, thus, their bargaining power from depreciating. Labor force participation gives them the opportunity to maintain a certain level of conflict payoff. Thus the instrumental variable estimation of labor supply with fitted wage rates derived from selectivity-bias corrected wage equation estimates and fitted conflict payoffs derived from payoff equation estimates supports the bargaining argument that there is a strategic aspect to female labor supply.

Appendix

Table 1

Step 1: Duration model for marital stability

Weibull model (n_w=662)	Coefficient estimate	T-value
Years of schooling wife	**-0.1278**	-2.651
Years of schooling husband	**0.1389**	3.368
Age at marriage wife	0.0027	0.111
Age at marriage husband	0.0275	1.274
First marriage - dummy	**0.8066**	2.579
σ	0.7092	0.7092
Constant	**2.8445**	3.677
- Log Likelihood	321	
- Log Likelihood (restricted)	332	

Shaded coefficients are significant at the 10%-level, bold coefficients at the 5%-level.
Data source: German Socio-Economic Panel 1985-1997.

Table2

Step 2: Conflict payoffs

OLS (n_w=96/ n_h=83)	**Conflict payoff**			
	wife		**husband**	
	Coeff.estimate	T-value	Coeff.estimate	T-value
Own age	34.94	1.46	-1.82	-0.05
Partner's age	-19.81	-0.85	24.09	0.63
Education	**135.33**	2.19	**180.54**	1.98
Partners education	-68.72	-1.26	-9.27	-0.08
Relative work experience	12.57	0.04	104.12	0.15
Partner's rel. work experience	**-987.51**	-2.25	601.00	1.37
Non-labor household income	**245.70**	3.47	95.13	0.88
Dummy child present (<16)	-99.005	-0.46	-71.56	-0.19
Age of youngest child (<16)	11.78	0.55	**81.81**	2.37
New marriage partner	**996.79**	3.73	-	-
New other partner	408.99	1.88	-	-
Constant	-42.39	-0.05	-1503.65	-1.01
Adjusted R^2	0.22		0.14	

Shaded coefficients are significant at the 10%-level, bold coefficients at the 5%-level.
Data source: German Socio-Economic Panel 1985-1997.

Table 3

Step 3: Female labor force participation

PROBIT (n_w=538)	**Labor force participation**			
	Coeff.estimate	T-value	Coeff.estimate	T-value
Constant	**1.2058**	2.073	**2.5842**	3.799
Age	**-0.1065**	-6.763	**-0.1045**	-6.046
Education	**0.2072**	5.269	**0.0935**	2.034
Work experience (full-time)	**0.1206**	8.035	**0.1263**	7.973
Work experience (part-time)	**0.1804**	8.606	**0.1738**	8.091
Non-labor household income	-0.0002	-1.698	**-0.0004**	-3.315
Dummy child present (<16)	**-1.7517**	-8.753	**-1.5355**	-7.170
Age of youngest child (<16)	**0.1183**	6.459	**0.1054**	5.520
Husband's wage income	**-0.0003**	-3.407	**-0.0004**	-4.542
Conflict payoff	-	-	**0.0005**	3.504
Symmetry indicator	-	-	**-1.6211**	-3.631
- Log Likelihood	244		226	
- Log Likelihood (restricted)	367		367	

Shaded coefficients are significant at the 10%-level, bold coefficients at the 5%-level.
Data source: German Socio-Economic Panel 1985-1997.

Table 4

Step 5: Female work hours

OLS (n_w=232)	**Hours of work**			
	Coeff.estimate	T-value	Coeff.estimate	T-value
Constant	**46.2725**	11.247	**45.3813**	9.432
Age	0.0896	0.430	-0.0445	-0.155
Education	-0.4155	-1.012	-0.8306	-1.725
Work experience (full-time)	-0.0239	-0.106	0.0959	0.297
Work experience (part-time)	**-1.0624**	-3.755	**-0.8773**	-2.171
Non-labor household income	-0.0012	-1.167	**-0.0027**	-1.946
Dummy child present (<16)	**-8.0515**	-2.874	**-11.1443**	-3.096
Age of youngest child (<16)	0.1475	0.633	0.3155	1.105
Husband's wage income	**-0.0016**	-2.099	**-0.0027**	-2.574
Predicted wage rate	-0.4439	-0.150	-0.0161	-1.881
Lambda	-5.2237	0.047	-2.3479	-0.553
Conflict payoff	-	-	**0.0065**	2.010
Symmetry indicator	-	-	9.1984	1.237
Adjusted R^2	0.496		0.500	

Shaded coefficients are significant at the 10%-level, bold coefficients at the 5%-level.
Data source: German Socio-Economic Panel 1985-1997.

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