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The Determinants of Specialization within Marriage

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Abstract

In this paper, we define measures of specialization and market intensity in the joint allocation of time and effort by married men and women. We use longitudinal data on wages, hours worked, and earnings from the Panel Study of Income Dynamics to estimate the changes in specialization that follow the birth of a couple's first child and the correlates of these changes. We find evidence of considerable heterogeneity and of joint decision-making in the effects of children on household behavior. We observe less specialization in the responses of both husbands and wives in couples from later birth cohorts, and with wives who remain continuously attached to the labor force. Couples who eventually divorce increase specialization less after the birth of a child, and other factors associated with divorce risk also reduce specialization. The gender of the first child has, surprisingly, a significant impact on the subsequent earnings of fathers.

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I. Introduction

Economic models of the family have emphasized the traditional division of labor between husbands and wives as a prinicipal source of the gains to marriage. In Becker's original formulation,[1] the family consumes "commodities" that it produces with inputs of market goods and services and the time of family members. If women have a comparative advantage in the provision of home time to these commodities, while men have a comparative advantage in earning the income that purchases market inputs, then family utility will be maximized by specialization in the time allocation of husbands and wives. The assumed female comparative advantage in home time is attributed to the gender gap in market wages and to a productivity advantage in household activities, including the care of children, that derives from biological factors or early training in domestic tasks. For any couple, the initial gains to specialization will be reinforced over time as husband and wife acquire skills specific to the market or domestic sectors.

The optimal degree of specialization in a marriage will depend upon the relative market and home productivities of husband and wife, and the household's ability to substitute market inputs for home time.[2] As real wages have increased in the United States, married women have allocated more time to market work and less to home production.[3] The home time of husbands has increased very little, so within-family specialization has declined through the substitution of market goods and services for women's home time, i.e. an increase in the market-intensity of the household's time use. The labor supply behavior of men and women with no children is now very similar,[4] but substantial husband-wife specialization persists in families with children.[5]

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[1] Becker [1973].
[2] This will depend upon the cost of market inputs relative to the family price of time, and upon the degree of substitution in production.
[3] Blau [1998].
[4] In 1992, 85% of women aged 20 to 54 with no children under 18 worked during the year, while 89% of men worked (Hayghe and Bianchi, 1994).
[5] 73% of married mothers worked during 1992; 95% of fathers worked and 76% of them worked full-time, year-round.

Parenthood reduces the total market intensity of the household by increasing the value of home time relative to market time, and, due to comparative advantage, it is typically the wife who reduces her commitment to the labor market to accommodate the increased demand for parental home time. The empirical literature reports substantial negative effects of motherhood on women's hourly wages and annual hours of work. There has been little attention paid to estimating the effect of fatherhood on men's labor market outcomes. However, in Lundberg in Rose [1998] we report that, on average, fatherhood is associated with an increase in the hourly wages and annual hours of work of married men while, as expected, these outcomes fall for their wives. It is this divergence in the annual hours of work, hourly wage rates, and therefore the annual earnings of husbands and wives that underlies the measure of specialization that we develop and study in this paper.

Specialization and variations over time and over populations in the degree of specialization are of interest because of their implications for gender inequality. A sizable portion of the gender gap in the earnings of men and women may be directly attributable to the divergence in the hours of market work and wage rates of husbands and wives due to parenthood.[6] To the extent that men and women anticipate a divergence of time and effort devoted to the labor market due to parenthood, the direct effects will be compounded by feedback effects on pre-parenthood human capital investments. If employers anticipate the parenthood-induced divergence, they may engage in statistical sex discrimination. Moreover, because wives who specialize in home production are investing in marriage-specific human capital, they will be disadvantaged upon divorce. This will directly affect their post-marriage well-being, and, in a bargaining framework, their well-being within marriage as well.

We have several objectives in this paper. First, we define and estimate measures of the change in specialization associated with parenthood, using longitudinal data from the PSID. Second, we estimate correlates of these changes. Our third objective is to

estimate the determinants of the change in specialization associated with parenthood. While our ability to conduct causal analysis is limited at this point, we present initial findings and discuss plans for the future.

We find evidence of joint decisionmaking and considerable heterogeneity in the estimates of the effects of children on household behavior and on specialization. Later cohorts in our sample increase specialization less than earlier birth cohorts through smaller responses to the birth by both husbands and wives. This cross-cohort change may be a response to increasing relative female wages, changing gender role norms, and/or increases in the perceived risk of divorce. We also find that when wives are continuously attached to the labor force, the couple exhibits a smaller increase in specialization after the birth of a child. This is due to smaller increases in men's hours of market work and hourly wages and smaller decreases in these outcomes for their wives.

We also find that higher divorce risk is associated with lower levels of specialization. Risk of divorce reduces the optimal degree of specialization for a married couple because the costs of divorce are higher for a couple in which the husband and wife have invested in undiversified skill portfolios. Specialization in home activities, in particular, is likely to generate human capital that is marriage-specific and so will lose value with dissolution of the marriage. A bargaining framework suggests an additional disadvantage to specialization in home activities: market skills, which are valuable outside the marriage and produce private, rather than public, goods, will increase the bargaining power and control over household resources of the spouse who works in the market relative to one who stays home. We find that couples who divorce within our sample period increase specialization less than those who do not, and that other characteristics associated with divorce risk, such as whether the father lived with both parents as a child, also reduce specialization. The gender of the first child has,

[6] Recent documentation of the "family gap" in women's wages can be found in Waldfogel [1997,1998] and England and Budig [1998].

surprisingly, a significant impact on the earnings of fathers. This pattern is consistent with the effect of child gender on the risk of divorce,[7] but deserves further study.

Section II of this paper reviews the literature regarding the relationship between parenthood, divorce and labor market outcomes, and introduces marital specialization as an indicator of the joint response to children. Section III discusses the conceptual underpinnings of the analysis. Section IV describes our empirical measure of the change in specialization associated with the first birth and a simple specification for describing heterogeneity in this response. Our longitudinal sample from the PSID is described in Section V, and results are discussed in Section VI. Section VII concludes.

II. Parenthood, Divorce, and Specialization: A Review of the Literature

The most obvious indicator of an increase in household specialization after the birth of a child is divergence between the hours of market work by husbands and wives. The literature on the effect of children on women's market work is enormous and concludes, in general, that there is a strong negative correlation between presence of young children in the household and measures of mother's labor supply.[8] The negative effect of children, particularly small children, on mother's labor supply has declined since 1970, but remains substantial.[9] Studies that instrument for fertility, which is likely to be correlated with tastes for work or labor market opportunities, usually find sharply reduced or even positive effects of childbearing on labor supply, but valid instruments are difficult to find. However, a recent study by Angrist and Evans [1996] uses the sex mix of the first two children and twin births as instruments for a third birth, and finds reduced but still substantial negative effects of fertility at this particular parity on women's labor supply. Using a large set of instruments that include state and county indicators of the

[7] Morgan, Lye, and Condron [1988].
[8] For a review, see Browning [1992].
[9] Leibowitz and Klerman [1995] also find that women's labor supply became more sensitive to their own earnings and less sensitive to those of their husbands over this period.

cost of fertility and fertility control, Klepinger et al. [forthcoming] find that adolescent fertility has significant negative effects on teen work experience.[10]

In contrast, little is known about the effects of parenthood on male labor market outcomes. It may be that, since male labor supply has been found to be relatively unresponsive to family variables such as wife's earnings, the household circumstances of men are assumed to be relatively unimportant determinants of their labor market experiences. Some older studies have found that father's labor supply is higher when children are young,[11] but Angrist and Evans find no significant effect of the birth of a third child on various measures of father's labor supply. Thus, increased specialization in the allocation of time has been regarded as a function of maternal response to children only.

One consequence of this child-induced specialization in the allocation of time is a post-child divergence in the market wage rates of mothers and fathers. It is well-known, from studies in many developed countries, that the wages of women with children are lower, all else equal, than the wages of women without children. The presence of young children in the household is associated with lower participation rates and hours worked for women, so that market productivity may be reduced through a reduction in work experience, loss of specific human capital, atrophy of market skills during a period out of the labor force, and reduced incentive to invest in training generating a payoff that depends upon future work. Becker [1985] has argued that women's productivity may be reduced by children not solely through a human capital effect, but also through a diversion of effort from market activities to home activities as children increase the relative return to the latter.[12] Alternatively, the negative relationship between female wages and children may be due not to a child-caused reduction in productivity, but to the selection of lower-productivity women into childbearing.

[10] And significant negative effects on formal education and adult wages as well.
[11] For example, see Pencavel [1986].
[12] Reduced market effort may take the form of choosing a job that offers a lower wage but more flexibility.

Recent studies have found that neither selection nor lower observed human capital of mothers, as measured by work experience and tenure, can explain all of the motherhood wage gap.[13] Attempts to control for the selection of low-wage women into motherhood using first-differenced longitudinal data have had mixed results: Korenman and Neumark [1992] find that the apparent direct effect of motherhood on wages disappears with first-differenced estimates,[14] suggesting that women with lower market wages are more likely to have children. Waldfogel [1997] finds a substantial family gap in women's wages that does not fall significantly in fixed-effect and first-difference models, and is not accounted for by losses in work experience. She suggests that very short intervals (one to two years) in previous first-difference estimates may account for the contrasting results. England and Budig [1998] find that differences in experience and seniority fail to explain most of the apparent effect of motherhood on the wages of young women in the NLSY. In Lundberg and Rose [1998] we find evidence of both selection effects and a causal relationship between parenthood and wages using fixed and random effects models. Using data on sisters to control for unobserved family-specific heterogeneity, Neumark and Korenman [1994] find that motherhood is associated with a significant decline in wages.

The effect of children on male wages has been largely ignored, though we find in our previous paper that fatherhood is associated with a substantial wage increase (Lundberg and Rose, 1998). The wage premium enjoyed by married men, however, has been well-documented, and is attributed partly to the selection of more productive men into marriage and partly to the increased productivity of men whose household responsibilities have been reduced by the presence of a wife.[15]

[13] A review of empirical studies of the "family gap" in the United States and other countries can be found in Waldfogel [1998]. She emphasizes that the family gap in women's wages has been rising in the U.S. during a period of rising relative female wages.

[14] Although their instrumental variables estimates indicate that children do reduce wages.

[15] In studies of the marriage premium in male wages, the effects of children are generally not reported (Korenman and Neumark, 1991 and Gray, 1997) or are reported to be insignificant (Loh, 1996).

On the basis of existing empirical results, we can expect that the arrival of children will be associated with an increase in specialization in marriage—with women reducing hours of market work and experiencing a reduction in wage rates, and men (possibly) increasing both market hours and wages. Although these changes in observed labor supply and in unobserved effort and time devoted to home production must be viewed as part of a joint household response, empirical work has typically failed to explicitly deal with the interrelationship of husbands' and wives' outcomes. One exception is Lundberg [1988] who finds that the presence of young children in the household changes the apparent relationship between husbands' and wives' work behavior: men and women in households with young children exhibit strong interactions in changes in their work hours which are not apparent in households with no children or with only older children. Gray [1997] finds that the marriage wage premium is smaller for men whose wives work. In Lundberg and Rose, we report that the labor supply response of men to the birth of their first child is strongly related to the labor market commitment of their wife—men whose wives are continuous participants reduce their work hours after the birth, while men whose wives interrupt their employment increase their work hours.

III. Conceptual Framework

What determines the joint response of husband and wife to the demands of caring and providing for a child? Consider a simple unitary model of the household, in which husband and wife choose their consumption, use of child care, and time allocations in order to jointly maximize a utility function that depends upon consumption, the leisure times of each, and the value of child services. This model suggests that key determinants will be male and female wage rates, non-labor income, the substitutability of the husband's and wife's leisure time, the price of market child care, and the properties of the child services function, i.e. substitutability between mother's time, father's time, and market inputs in the production of child services. Without a restrictive set of assumptions, such a model generates few testable hypotheses, though we can expect the market time of each parent to be increasing in his or her own wage, and the total work

time of the parents to be decreasing in the price of market child care. To the extent that market wages are endogenous, and respond to child-induced changes in the allocation of time and choice of job characteristics, these implications will be difficult to test.

In a dynamic version of this model, the probability of marital dissolution should affect the division of labor. A highly-specialized couple will invest in sector-specific skills and face substantial divorce costs when the opportunities for marital exchange disappear. In addition, specialization in home production may entail investments in marriage-specific human capital that will lose value when the couple divorces. We therefore expect to see less specialization among couples whose perceived risk of divorce is higher. There is some evidence of such a relationship for the time allocation of women only: Johnson and Skinner [1986] found that the labor supply of married women rises significantly several years before they divorce, and Gray [1995] finds an increase in women's labor force participation two to three years prior to divorce that is due largely to an increase in the percentage of wives working in professional and managerial occupations. The effect of divorce risk on the behavior of husbands has not, to our knowledge, been investigated.

A bargaining model of marital decision-making introduces some additional elements to the analysis of post-child specialization. In a cooperative model of marital bargaining, outcomes and individual well-being will be affected by the threat points of the husband and wife, which in turn depend upon control of income or other resources within the family, or expected well-being in case of divorce.[16] This implies that labor supply decisions of husbands and wives, and, therefore, specialization and market-intensity of responses to parenthood, will depend upon "extrahousehold environmental parameters"[17] such as divorce laws,[18] remarriage market conditions, and welfare generosity. In a dynamic bargaining model, strategic considerations will affect the degree of specialization we expect to see in response to parenthood, since the wife's reduction of

[16] The threat point is determined by the marital partner's best alternative to a cooperative marital equilibrium, which may be internal to the marriage (Lundberg and Pollak, 1993) or external (McElroy, 1990).
[17] McElroy [1990].

market work will reduce her long-run accumulation of market human capital and therefore her well-being in the event of divorce. Wells and Maher [1996] show that this will lead to "too much" market work and "too little" production of household public goods when husbands are unable to indemnify wives for future losses associated with specialization.

Despite these complexities, we can empirically describe the joint changes in time use by husband and wife in terms a change in the degree of specialization (ΔS, or the change in the difference between market hours of the husband and wife) and a change in the market intensity of the household (ΔMI, or the change in the sum of market hours worked by the couple). A joint response diagram (JRD) illustrates the relationship between these dimensions of the marital response and individual work hours:

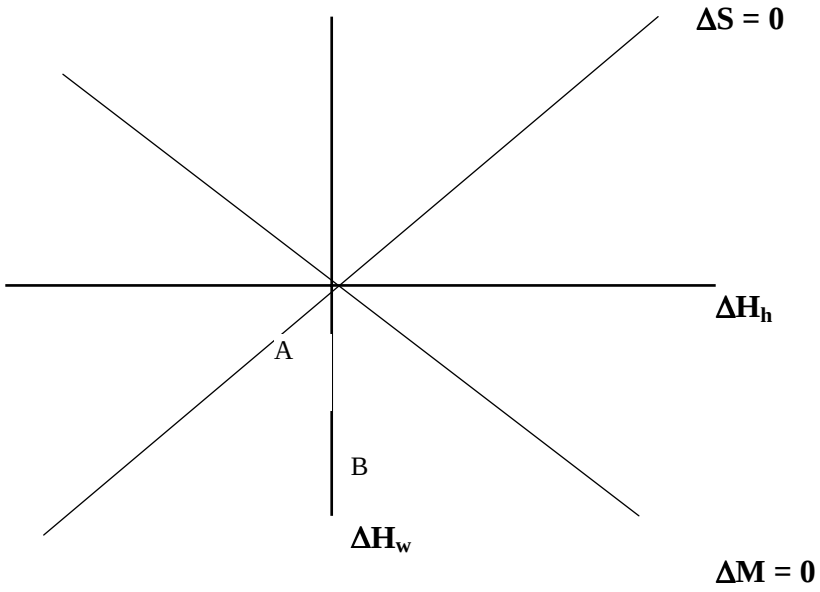

Figure 1

The horizontal axis of the JRD measures the response of husband's hours to parenthood and the vertical axis measures the response of mother's hours to parenthood. The upward sloping 45 degree line is the locus of points representing no change in the level of

[18] Gray [1998] has found a significant impact of divorce law changes in the U.S. on married women's labor supply.

specialization ($\Delta S = \Delta H_h - \Delta H_w = 0$). Points below (above) the line represent increases (decreases) in specialization. The downward sloping 45 degree line is the locus of points representing no change in market intensity ($\Delta MI = \Delta H_h + \Delta H_w = 0$). Points below (above) the line represent decreases (increases) in market intensity. In our previous study using a pilot sample, we found considerable heterogeneity in household responses to children, with couples in which the wife is a continuous participant exhibiting a much smaller fall in specialization and market intensity (A) than couples in which the wife was not a continuous participant (B). In this paper, we plan to concentrate on patterns of post-child specialization in a larger sample of couples, leaving a more complete analysis of changes in both specialization and market intensity to future work.

The principal aim of this paper is to describe the pattern of marital specialization that follows the birth of the first child, including responses by both mothers and fathers. Because some part of specialization arises through allocation of effort and the acceptance of compensating wage penalties for jobs that allow for flexibility, we examine the effect of the birth of a child on hourly wages as well as hours of work, and on annual earnings, which subsumes the effects on wage rates and labor supply.

In summary, we would expect the degree of specialization in a marriage to be related to divorce risk, parameters reflecting the spouses' threat points, the price of child care and the penalties that spouses incur when they reduce their commitment to the labor market. We would expect that specialization has fallen over time, as changes in divorce probabilities, divorce laws, female labor force participation, and social norms relating to women's role in the family have changed. Since, over the time period we study, the level of specialization within marriage prior to the birth of the first child is relatively low, most of the variation in the level of specialization will be reflected in the variation in the change in specialization, ΔS. Therefore, we can describe patterns in specialization by estimating the extent to which ΔS varies by cohort, with indicators of wives' labor force commitment, and with variables which reflect divorce risk. The methodology which we use to undertake this analysis is described in Section IV.

IV. Empirical Specification

Changes in specialization in terms of hours of work are estimated with the reduced form labor supply equations:

$$H^h_{it} = \alpha^h_i + \beta^h AFTER_{it} + \theta^h X^h_{it} + u^h_{it} \quad (1a)$$

$$H^w_{it} = \alpha^w_i + \beta^w AFTER_{it} + \theta^w X^w_{it} + u^w_{it} \quad (1b)$$

where α^j_i is an individual specific fixed effect, H^j_{it} is annual hours of work for spouse j in couple i in year t, $AFTER_{it}$ is a dummy variable indicating that the first child was born to couple i prior to year t, and X is a set of control variables. The variables in X include age, education and year (all entered as dummy variables to capture non-linearities), and a dummy variable $BORN_{it}$ which equals one in the year in which the child was born.[19] The estimate of the change in specialization generated from this base specification is:

$$\Delta S = \beta^h - \beta^w \quad (2)$$

ΔS measures the divergence in husbands' and wives' hours of work due to the birth of a child.

We report two sets of estimates of (1a) and (1b). In the first, the equations are estimated individually under standard fixed effects. Fixed effects estimation controls for any heterogeneity/endogeneity based on individual specific unobservables. This eliminates various potential biases that would be problematic in cross section estimates. For example, cross section estimates of the effect of motherhood on earnings would likely be biased downward because women who prefer home production to market work will be more likely to have children and also accumulate less human capital. Similarly, women

[19] The individual's wage rate is excluded because human capital accumulation and labor supply decisions are jointly determined.

with less-marketable skills will be more likely to have children, generating a negative bias. To the extent that the effects of preferences and ability are fixed over time, fixed effects will eliminate these biases.[20] Fixed effects estimates can also eliminate biases due to assortative mating in estimating the effect of one spouse's characteristics on the outcomes or behavior of the other spouse. An additional endogeneity issue is selection into marriage and divorce since the sample consists only of married individuals. To the extent that this selection is based on characteristics that have a fixed effect on the outcome, this potential source of bias is eliminated as well.

The second set of estimates is produced under Fixed Effects Seemingly Unrelated Regressions (FESUR). FESUR allows for contemporaneous correlation between u^h_{it} and u^w_{it} and has three advantages over standard Fixed effects. First, the estimates are more efficient. Second, under FESUR it is possible to formally test cross-equation restrictions, such as the restriction that the change in specialization, or $\beta^h - \beta^w$, equals zero. Third, FESUR produces an estimate of ρ, the correlation between u^h_{it} and u^w_{it}. A negative estimate of ρ indicates that, net of the effects of observables in (1a) and (1b), husbands' hours tend to increase when wives' hours decrease.

Since numerous studies show that motherhood is associated with lower levels of participation and labor supply, we would expect that $\beta^w < 0$. Our priors regarding β^h are less clear. Previous research has failed to find a consistent effect of children on fathers' labor supply. Also, we would expect heterogeneity in this effect across households. In more traditional households, fatherhood would be associated with an increase in labor supply if men increase their commitment to market work as women's commitment to the labor market falls. In less traditional households, men may also reduce their commitment in order to share in caring for the child. In either case, we would not expect that any fall in men's labor supply would match the fall in wives' labor supply overall, so we would expect that $\Delta S > 0$.

[20] However, endogenous timing in fertility with respect to shocks to earnings may still generate negative biases. For example, if women tend to have their first child at a time in which they (correctly) expect to be underemployed, even the Fixed Effects coefficients will be biased downward.

We estimate two additional sets of equations of the same form as (1a) and (1b), and construct measures of ΔS in which the outcome variables are husbands' and wives' hourly wage rates, and husbands' and wives' annual earnings. We note that estimating the wage equations under FESUR is problematic because the system can only be estimated on observations which have observed wages for both the husband and wife. The usual problems of selection and representativeness that arises in estimating women's wage equations extend to the husbands' wage equations.

Estimates of the β's from the wage equations indicate the impact of parenthood on the hourly wage rate. For women, we would expect this effect to be negative, as numerous studies have shown that motherhood is associated with a fall in hourly wages. This decline may be attributed to a reduction of effort expended for each hour of market work, a compensating variation due to a change in job characteristics in order to accommodate family responsibilities, a loss of specific human capital due to a work interruption, or foregone human capital accumulation associated with the drop in labor supply/participation.[21] Similarly, any changes in husbands' wages due to fatherhood reflect differences due to reallocation of effort, compensating variations due to a change in job characteristics, and the cumulative effect of changes in labor supply.[22] The effects of parenthood on annual earnings subsume the effects on labor supply/participation, as well as the effects on hourly earnings.

After estimating the base specification on all three dependent variables, we examine some sources of heterogeneity in post-child responses of couples by introducing variables which will be interacted with *AFTER* into each of the three sets of equations. To test whether the changes in specialization associated with parenthood, in terms of hours worked, are different for two groups of couples, we estimate:

[21] Unlike most of the literature on the family gap in women's wages, our earnings and wage equations do *not* include cumulative experience, which is an endogenous component of the response to parenthood. Our estimates of the impact of motherhood on hourly wages should be interpreted as being gross of the experience effects.

[22] And, in principle, penalties due to a career interruption.

$$H^h_{it} = \alpha^h_i + \beta^h AFTER_{it} + \gamma^h AFTER_{it}V_{it} + \theta^h X^h_{it} + u^h_{it} \quad (3a)$$

$$H^w_{it} = \alpha^w_i + \beta^w AFTER_{it} + \gamma^w AFTER_{it}V_{it} + \theta^w X^w_{it} + u^w_{it} \quad (3b)$$

where $V = 1$ indicates that the couple belongs to some group and $V = 0$ denotes that the couple does not.[23] For example, $V = 1$ could indicate that the wife was born prior to 1950. Equations (3a) an (3b) constitute our interacted specification.

The difference between the changes in specialization associated with parenthood between the two groups is:

$$\Delta(\Delta S) = \Delta S_{V=1} - \Delta S_{V=0} = [(\beta^h + \gamma^h) - (\beta^w + \gamma^w)] - [\beta^h - \beta^w]$$
$$= \gamma^h - \gamma^w \quad (4)$$

Under FESUR we can test whether this difference is significant. We can also test for differences in the change in specialization between two groups in terms of hourly wage rates and annual earnings by estimating equations of the form of (3a) and (3b) with the dependent variables as hourly wages and earnings.

There are additional heterogeneity/endogeneity issues that arise in the interacted specifications that may interfere with our ability to interpret an estimate of γ^j as the *effect* of V on the response of spouse j to parenthood, or the estimate of $\gamma^h - \gamma^w$ as the *effect* of V on the change in specialization. These issues will be discussed as they arise in Section VI. To the extent that our objective is to describe heterogeneity in the amount of specialization in households, there is less need for concern in establishing a causal relationship at this point.

[23] There is an additional variable in "X" in these specifications: the interaction of the dummy variable representing the year in which the child is born with "V".

V. Data

The data for this analysis are obtained from the Panel Study of Income Dynamics (PSID). We have constructed a panel data set on married couples over a window of the marriage of up to 25 years, from 1968 until 1992. Because the objective of the study is to capture the effect of parenthood, we have included only marriages in which the wife's first child was born within the marriage. Observations on couples in which the husband was over 60 years old, the wife was over 55 years old, and either the husband or the wife was less than 18 years old were deleted, as were observations for which data on key variables were missing. The final data set consists of 17801 observations on 1240 couples, and the median number of years in the sample for a marriage is 14. The dependent variables in the base specifications are annual hours of work, the (log of the real) hourly wage rate, and (real) annual earnings. The independent variables are a dummy variable indicating that the first child was born prior to that year (*AFTER*), and dummy variables indicating the year of the observation, the individual's age, the individual's education, and whether the first child was born in that particular year.

A set of variables appear in the interacted specification in order to test for differences in the change in specialization between groups. These "*V*" variables include: *PRE50* (whether the wife was born before 1950), *CONTINUOUS* (whether the wife worked at least 1 hour in each year, except the year in which she had a child), *DIVORCE* (whether the couple eventually divorced), *BOY* (whether the first child was a boy), *LIVEPAR1* (whether the husband lived with both parents when he was growing up), and *LIVEPAR2* (whether the wife lived with both parents when she was growing up).

VI. Results

In this section we first discuss the results of the estimation of the base specification for each of the three outcomes (hours, wages, and earnings). Then we discuss the six interacted specifications.

Table 1: Base Specification

The results for the base specification are reported in Table 1. The top panel of the table reports the estimates when the equations are estimated individually under Fixed effects, and the bottom panel reports the results when the equations are estimated under FESUR. For each specification, we report the coefficient on *AFTER* and the associated t-statistic, the number of observations, and the measure of the change in specialization. For the SUR results, we also report the p-value associated with the test that $\Delta S = 0$, the estimate of ρ (the correlation between the error terms in the husbands' and wives' equations), and the p-value associated with the test that $\rho = 0$.

Columns (1) and (2) report the results for husbands' and wives' hours, respectively. The estimated coefficients, and therefore the estimate of ΔS, are virtually identical under fixed effects and FESUR. We find that men work, on average, 130 hours more (or about two and a half hours more per week) after becoming fathers, relative to before. That women work substantially (over 1000 hours per year) less after becoming mothers is a common finding. However, the effect of parenthood on men's labor supply has received scant attention and our finding that there exists a quantitatively and statistically significant increase suggests that the husbands' and wives' decisions are interdependent, and the household as a whole becomes more specialized when a child is born.

The results imply an increase in specialization, or a divergence in market hours, of approximately 1175 hours per year, which is highly statistically significant. The estimate

of ρ is negative and significant, indicating that, net of the effects of the observables, changes in husbands and wives hours are negatively correlated. This is additional evidence that husbands' and wives' labor supply decisions are interdependent.[24]

Columns (3) and (4) report the results for the equations in which the dependent variable is (the log of the real) hourly wage rate. The Fixed effects estimates indicate that parenthood leads to an increase in husbands' wage of 12 percent, and a fall of 21 percent for wives, yielding an estimated increase in specialization in terms of log hourly wages of .33.[25] We note that our estimate of the effect of motherhood on earnings is larger than other estimates in the literature (see Waldfogel 1998). In part, this is because our estimates are gross of the effects of human capital variables such as experience and tenure.[26]

The FESUR estimates are somewhat different for husbands; this is probably due to the fact that the husbands' equation is estimated only for the sample of husbands whose wives work in a particular year. The implied measure of the change in specialization is .29 and highly statistically significant. The estimate of ρ here is positive and significant. However, rather than reflecting coordination (or lack thereof) between husbands and wives, the positive correlation most likely reflects common unobservables affecting the wage growth of working husbands and wives, such as changes in local labor market conditions, or, perhaps, assortative mating based on characteristics associated with wage growth.

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[24] Note that Hamermesh [1998] finds that husbands' and wives hours of work are positively correlated over the course of the day, i.e., that within the day spouses hours of home time are complementary, and that this correlation declines with children. We find it quite plausible that husbands' and wives hours are complements over the course of the day but substitutes within the year.

[25] Note that since $\ln(WAGE^{h}_{it}/WAGE^{w}_{it}) = \ln(WAGE^{h}_{it}) - \ln(WAGE^{w}_{it})$ we can interpret $\gamma^{h} - \gamma^{w}$ as the percentage change in the relative wages of husbands and wives.

[26] Another reason our estimated wage penalty is somewhat larger than others in the literature is that we are only addressing the effect of the transition into parenthood. The coefficient on *AFTER* reflects effects of subsequent children along with the effect of the first child. We would expect the birth of the first child to be associated with a greater shift in household roles than births of subsequent children. To some extent, heterogeneity in responses may be due to heterogeneity in number of children born to parents. Of course, these conjectures are testable within our framework, and in future work we will enter variables reflecting the presence of subsequent children.

The results for earnings are reported in columns (5) and (6). The drop in wage rates and labor supply associated with motherhood leads to an average fall in annual earnings of approximately $7300 per year. The increases in hourly wages and labor supply associated with fatherhood lead to an increase in earnings of approximately $5600 per year. The estimate of ρ is negative and significant.

In summary, we have found strong evidence that specialization within the household increases after the birth of a child using all three measures of specialization, and that this arises through a change in hours of work and wages for both husbands and wives. Additional evidence in favor of substitution of time is provided by the significantly negative correlation of the error terms in the hours and earnings equations.

Tables 2 through 7: Interacted Specifications

In Tables 2 through 7 we report the results for a series of interacted specifications in order to test for differences in specialization between subgroups of the population. The format of these tables is similar to the format of Table 1. We report the coefficients and associated t-statistics for the variables *AFTER* and *V*AFTER* where *V* is some variable indicating presence in a particular subgroup. These two reported estimates correspond to the β and γ coefficients, respectively, in equations (3a) and (3b). We also report the estimated difference in the amount of specialization between the subgroups; i.e., $\Delta(\Delta S) = \gamma^h - \gamma^w$ from (4). In the equations estimated under FESUR we also report the p-value associated with the hypothesis test that $\Delta(\Delta S) = \gamma^h - \gamma^w = 0$; i.e., the test for a significant difference in the change in specialization between the groups $V = 1$ and $V = 0$.[27]

[27] The estimates of ρ from the interacted specifications were virtually identical to those from the comparable base specifications, and therefore are not repeated in Tables 2 through 7.

Table 2: Cohort Interaction

Because massive changes in divorce laws and practice, and in female labor market behavior, occurred over our sample period, we would expect patterns in specialization to have changed dramatically as well. In Table 2, we explicitly test for a significant difference in specialization for couples by cohort by dividing the sample into two groups: those in which the wife was born prior to 1950 (*PRE50* = 1), and couples in which she was born in 1950 or later (*PRE50* = 0).[28] The decreases in women's hours worked, hourly wages and annual earnings associated with parenthood, as well as the associated gains for men are significantly larger (in absolute value) for the earlier cohort. These results imply higher levels of specialization of approximately 300 hours, .20 log dollars per hour in wages, and $5000 per year in annual earnings more for the earlier cohorts; these changes in specialization are all highly statistically significant.

Table 3: Continuous Participant Interaction

In the second interacted specification we interact a variable *CONTINUOUS*, which indicates whether the wife participated in each year of the panel except the year in which a child was born, with the *AFTER* dummy. The results are reported in Table 3. The wage penalty due to motherhood is completely eliminated for women who participate continuously. The husbands in the *CONTINUOUS* couples have significantly less of a gain in wages, hours worked, and earnings associated with parenthood. This suggests that husbands and wives jointly respond to the change in the household's time allocation problem due to parenthood.[29]

[28] We have chosen the year 1950 as the breaking point because it is for this cohort of women that Smith and Ward [1985] first find that labor force participation is persistent throughout the childbearing years.

[29] We note that because of the high degree of endogeneity of *CONTINUOUS*, we must be particularly cautious in drawing causal inferences here. This is particularly true with respect to women's labor supply and wages. That women who work continuously will have less of a drop in labor supply due to motherhood will be true by construction. In terms of wages, the smaller (or absence of a) fall in wages for continuous participants could be explained in part by the fact that women with high wage growth are less likely to withdraw from the labor force upon motherhood. In terms of joint labor supply behavior, it could be that women whose husbands face low wage growth or underemployment maintain participation in order to maintain family income and/or because the husband may be available to devote more time to home production.

Table 4: Divorce Interaction

In Table 4 we begin to examine the relationship between divorce and specialization by interacting the variable *DIVORCE*, which equals 1 if the couple divorced within the sample period, with *AFTER*. The fixed effects results indicate that men in marriages which end in divorce increase their earnings by significantly less per hour and per year than men in marriages that don't end in divorce, and the women in these marriages reduce their work hours and earnings by significantly less per year after their first child is born. These lead to measures of differences in specialization between the groups that are negative for all three outcomes. Under FESUR, the estimated coefficient on *DIVORCE*AFTER* in the husbands' earnings equations is negative and significant and the estimated differences in the amount of specialization in divorcing households relative to those that remain intact is negative and significant for all three outcomes.

While we can conclude that divorce is associated with less post-child specialization, we are unable to tell the direction of the causality underlying this relationship. It could be that expectations of divorce generate less specialization. Because more specialization increases the cost of divorce, couples who believe that it is likely that a marriage will dissolve will limit the extent they will specialize. On the other hand, less specialization could make divorce more likely, since less specialization corresponds to a lower level of marital surplus.[30]

The problem of disentangling the causality in the relationship between divorce and specialization adds an additional dimension to the problem of determining the direction of the causality between divorce and female labor force participation - one of the classic "chicken and egg" problems in labor economics. In Tables 5 through 7 we provide further evidence relating to the relationship between divorce and specialization and in Section VII we propose approaches to estimating the effect of divorce on

[30] Other endogeneity and heterogeneity issues are associated with the *DIVORCE* and *CONTINUOUS* variables. First, couples who married earlier are in the sample longer and are more likely to have

specialization - many have which been used in the literature on divorce and participation - which are less prone to endogeneity and heterogeneity bias.

Table 5: Boy Interaction

Our motivation for interacting the variable *BOY*, indicating whether the first child is a boy, with *AFTER* is the finding first reported by Morgan, Lye and Condron that the presence of a boy in a marriage reduces the likelihood of divorce by 7 percent more than the presence of a girl. The results in Table 5 indicate that, in terms of annual earnings, specialization is higher if the parents have a boy rather than a girl as their first child. This arises because husbands' earnings are substantially (over $3000) higher per year is a son is born rather than a daughter. The fixed effects estimates indicate that this is due to an increase in both the hourly wage and annual hours worked, although only the coefficient in the earnings equation is statistically significant under FESUR. Morgan et al speculate that the presence of a boy increases husbands' commitment to the marriage, we believe that this induces him to consume less leisure and work harder as well.[31, 32]

Tables 6 and 7: Whether Husband/Wife Lived with Both Parents While Growing Up

In Tables 6 and 7 we interact variables representing whether the husband and wife, respectively (*LIVEPAR*1 and *LIVEPAR*2), lived with both parents when growing up. Because success of an individual's parents' marriage would be expected to be correlated with the likelihood of success of his/her own marriage, the *LIVEPAR* variables indicate an expectation that the marriage will succeed. While these variables may reflect

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experienced a divorce or a year of wife's non-participation or, all other things being equal. Second the components of ΔS may be correlated with unobservables which also affect *DIVORCE* or *CONTINUOUS*.

[31] Our preliminary work on estimating the determinants of home production time indicate that men spend more hours in home production if they have a son relative to a daughter. This implies that the increased commitment to market work due to the birth of a son is due to a drop in leisure rather than in home production time.

[32] These findings could in principle arise due to selection based on marital status. For instance, the positive coefficient on *BOY*AFTER* would arise if there is no difference in labor market behavior of fathers of sons vs. daughters, but men who have sons and divorce are a lower quality pool (in terms of unobservables in the earnings equations) than men who have daughters and divorce. However, we ran wage and reduced form hours equations under fixed effects for *all* men (i.e., not selected on marital status) and found that fathering a boy relative to a girl leads to greater hours of work and hourly wages.

unobservable components of family background, they are exogenous in the sense that they are predetermined at the time of the marriage.

We find that there is significantly more specialization, when measured in terms of annual earnings, in households in which the husband lived with both parents when growing up. This arises primarily through wives' earnings. However, there is no significant effect of the stability of wives' parents' marriage on the amount of specialization. This contrast is consistent with the fact that in general it is wives who are more vulnerable to economic hardship upon divorce when specialization is higher since their investment in marriage market human capital is generally not transferable in the market.

VII. Conclusion and Extensions

In this paper we have defined and estimated measures of the change in specialization within marriage that reflect the divergence in spouses' labor market hours, hourly wages, and earnings associated with parenthood. Not surprisingly, we find that specialization increases after a couple's first child is born. The results confirm our expectation that there has been a decline in specialization among more recent cohorts that might be attributed to a higher probability of divorce and other factors that have increased lifetime female labor force participation. However, the variables with which we initially measure women's labor force commitment and the likelihood of divorce (*CONTINUOUS*, and *DIVORCE*, respectively) are endogenous and, though the results reveal some interesting patterns in marital specialization, causal inferences based on these estimates cannot be made. Estimates of the effect of exogenous variables related to the likelihood of divorce (the sex of the first child and the stability of marriages in the preceding generation) on the changes in earnings due to parenthood are less problematic.

We would like to understand the causes of the decline in marital specialization over time, and plan to extend these results by analyzing the effects of two sets of exogenous variables on our measures of specialization and market intensity: those that

directly affect labor supply and human capital investment decisions, and those that affect the risk of divorce. The labor market variables include local labor market conditions and family leave policy, and divorce related variables includes extrahousehold environmental parameters, such as marriage market conditions, divorce laws and welfare laws that affect the relative well-being of the spouses in the event of divorce as well as variables which affect the risk of divorce but not the threat points.

Our results show that well-known patterns of decreased market work and wages for mothers are part of a joint household response to demands of childrearing that includes significant changes in the hours worked and wages of fathers, and that there is considerable heterogeneity across couples in this response. Our approach has been largely descriptive: the analysis of family time allocation and children needs to be embedded in a more formal behavioral model in future work. The results concerning divorce, divorce risk, and marital specialization suggest that the prospect of marital dissolution and expected well-being outside marriage need to be considered in modeling these household decisions.

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Table 1 [a]

Effect of the Birth of the First Child on Wages, Hours and Earnings

		(1) Husband Hours	(2) Wife Hours	(3) Husband Wage	(4) Wife Wage	(5) Husband Earnings	(6) Wife Earnings
Fixed Effects	*AFTER*	129	-1046	.12	-.21	5567	-7277
	(t)	(7.4)	(53)	(8.5)	(10.3)	(12.3)	(42.9)
	N	17801	17801	17480	12913	17801	17801
	ΔS	1175		.33		12844	
Fixed Effects SUR	*AFTER*	130	-1047	.09	-.20	5579	-7283
	(t)	(10.5)	(75)	(8.1)	(14.3)	(17.5)	(60.1)
	N	17801		12688		17801	
	ΔS	1176		.29		12861	
	(p)	(0)		(0)		(0)	
	ρ	-.02		.07		-.05	
	(p)	(.007)		(0)		(0)	

[a] *AFTER*: After the birth of the first child. Wage: (log of the real) hourly wage rate. Hours: annual hours worked. Earnings: (real) annual earnings. Controls include: dummies for year of age, years of education, year of observation, and whether the first child was born in the year.

Table 2 [a]

Cohort Interaction

Difference in the Effect of the Birth of the First Child on Wages, Hours and Earnings for Wife Was Born Before 1950 (*PRE50*=1) vs. Not

		(1) Husband Hours	(2) Wife Hours	(3) Husband Wage	(4) Wife Wage	(5) Husband Earnings	(6) Wife Earnings
Fixed Effects	*AFTER*	88	-990	.09	-.18	5034	-6151
	(t)	(4.2)	(42)	(5.2)	(7.4)	(4.3)	(30)
	PRE AFTER*	120	-165	.08	-.09	1500	-3265
	(t)	(3.6)	(4.3)	(3.2)	(2.3)	(1.7)	(10)
	N	17801	17801	17480	12913	17801	17801
	$\Delta(\Delta S)$	285		.17		4765	
Fixed Effects SUR	*AFTER*	87	-986	.08	-.14	4379	-6009
	(t)	(6.3)	(61)	(6.3)	(8.7)	(12)	(44)
	PRE AFTER*	116	-188	.06	-.16	2179	-3642
	(t)	(2.8)	(4.0)	(1.6)	(3.8)	(2.1)	(9.2)
	N	12688		17801		17801	
	$\Delta(\Delta S)$	303		.22		5826	
	(p)	(0)		(0)		(0)	

[a] *AFTER*: After the birth of the first child. Wage: (log of the real) hourly wage rate. Hours: annual hours worked. Earnings: (real) annual earnings. Controls include: dummies for year of age, years of education, year of observation, and whether the first child was born in the year, and an interaction of *PRE50* with whether the first child was born in the year .

Table 3 [a]

Continuous Participation Interaction

Difference in the Effect of the Birth of the First Child on Wages, Hours and Earnings for Wife Works Continuously (*CONTINUOUS*=1) vs. Not

		(1) Husband Hours	(2) Wife Hours	(3) Husband Wage	(4) Wife Wage	(5) Husband Earnings	(6) Wife Earnings
Fixed Effects	*AFTER*	154	-1261	.14	-.35	7216	-9936
	(t)	(7.5)	(54)	(8.8)	(14)	(14)	(50)
	CON* *AFTER*	-66	580	-.07	.29	-4469	7187
	(t)	(2.2)	(17.3)	(3.1)	(9.2)	(5.8)	(25.3)
	N	17801	17801	17480	12913	17801	17801
	$\Delta(\Delta S)$	-646		-.36		-11656	
Fixed Effects SUR	*AFTER*	146	-1262	.11	-.35	6552	-9935
	(t)	(10)	(77)	(7.7)	(20)	(17)	(72)
	*CON** *AFTER*	-57	570	-.02	.31	-3971	7267
	(t)	(1.5)	(12.3)	(.7)	(7.8)	(3.9)	(19.5)
	N	17801		12688		17801	
	$\Delta(\Delta S)$	-628		-.34		-11238	
	(p)	(0)		(0)		(0)	

[a] *AFTER*: After the birth of the first child. Wage: (log of the real) hourly wage rate. Hours: annual hours worked. Earnings: (real) annual earnings. Controls include: dummies for year of age, years of education, year of observation, and whether the first child was born in the year, and an interaction of *CONTINUOUS* with whether the first child was born in the year .

Table 4 [a]

Divorce Interaction

Difference in the Effect of the Birth of the First Child on Wages, Hours and Earnings for Couples who Divorced within the Period (*DIVORCE*=1) vs. Not

		(1) Husband Hours	(2) Wife Hours	(3) Husband Wage	(4) Wife Wage	(5) Husband Earnings	(6) Wife Earnings
Fixed Effects	*AFTER*	134	-1056	.12	-.21	5821	-7382
	(t)	(7.5)	(52)	(8.7)	(10.5)	(13)	(42)
	DIV AFTER*	-66	131	-.08	.10	-3562	1424
	(t)	(1.2)	(2.0)	(1.8)	(1.5)	(2.4)	(2.6)
	N	17801	17801	17480	12913	17801	17801
	Δ(ΔS)	-197		-.18		-4986	
Fixed Effects SUR	*AFTER*	130	-1055	.10	-.20	5346	-7271
	(t)	(10)	(75)	(9.1)	(14)	(17)	(60)
	DIV AFTER*	-78	111	-.10	.05	-3897	1015
	(t)	(1.0)	(1.3)	(1.5)	(.5)	(2.0)	(1.4)
	N	17801		12688		17801	
	Δ(*ΔS*)	-189		-.15		-4912	
	(p)	(.002)		(.01)		(0)	

[a] *AFTER*: After the birth of the first child. Wage: (log of the real) hourly wage rate. Hours: annual hours worked. Earnings: (real) annual earnings. Controls include: dummies for year of age, years of education, year of observation, and whether the first child was born in the year, and an interaction of *DIVORCE* with whether the first child was born in the year .

Table 5 [a]

Boy Interaction

Difference in the Effect of the Birth of the First Child on Wages, Hours and Earnings for First Child is a Boy (*BOY*=1) vs. Not

		(1) Husband Hours	(2) Wife Hours	(3) Husband Wage	(4) Wife Wage	(5) Husband Earnings	(6) Wife Earnings
Fixed Effects	*AFTER*	101	-1073	.09	-.22	3802	-7342
	(t)	(4.4)	(41)	(5.0)	(8.7)	(6.4)	(32)
	BOY* *AFTER*	54	51	.05	.04	3344	121
	(t)	(1.9)	(1.6)	(2.2)	(1.1)	(4.5)	(.4)
	N	17801	17801	17480	12913	17801	17801
	$\Delta(\Delta S)$	3		.01		3223	
Fixed Effects SUR	*AFTER*	99	-1076	.09	-.21	3439	-7230
	(t)	(6.2)	(59)	(6.1)	(11)	(8.2)	(46)
	CON* *AFTER*	47	53	.02	.02	3108	57
	(t)	(1.3)	(1.3)	(.56)	(.52)	(3.2)	(.16)
	N	17801		12688		17801	
	$\Delta(\Delta S)$	-6		0		3051	
	(p)	(.8)		(.9)		(0)	

[a] *AFTER*: After the birth of the first child. Wage: (log of the real) hourly wage rate. Hours: annual hours worked. Earnings: (real) annual earnings. Controls include: dummies for year of age, years of education, year of observation, and whether the first child was born in the year, and an interaction of *BOY* with whether the first child was born in the year .

Table 6 [a]

Husband Lived with Both Parents Interaction

Difference in the Effect of the Birth of the First Child on Wages, Hours and Earnings for Husband Lived with Both Parents when Growing Up (*LIVEPAR1*=1) vs. Not

		(1) Husband Hours	(2) Wife Hours	(3) Husband Wage	(4) Wife Wage	(5) Husband Earnings	(6) Wife Earnings
Fixed Effects	*AFTER*	178	-987	.10	-.21	4153	-6388
	(t)	(3.7)	(18)	(2.7)	(4.1)	(3.3)	(14)
	LP1 AFTER*	-54	-65	.02	.002	1555	-975
	(t)	(1.1)	(1.2)	(.4)	(.03)	(1.2)	(2.0)
	N	17801	17801	17480	12913	17801	17801
	Δ(ΔS)	11		.018		2530	
Fixed Effects SUR	*AFTER*	174	-991	.08	-.17	3950	-6249
	(t)	(5.1)	(26)	(2.8)	(4.6)	(4.5)	(18.8)
	LP1 AFTER*	-55	-62	.02	-.03	1242	-1045
	(t)	(.9)	(.8)	(.4)	(.4)	(.7)	(1.6)
	N	17801		12688		17801	
	Δ(*ΔS*)	7		.05		2287	
	(p)	(.9)		(.3)		(.02)	

[a] *AFTER*: After the birth of the first child. Wage: (log of the real) hourly wage rate. Hours: annual hours worked. Earnings: (real) annual earnings. Controls include: dummies for year of age, years of education, year of observation, and whether the first child was born in the year, and an interaction of *LIVEPAR1* with whether the first child was born in the year .

Table 7 [a]

Wife Lived with Both Parents Interaction

Difference in the Effect of the Birth of the First Child on Wages, Hours and Earnings for Wife Lived with Both Parents when Growing Up (*LIVEPAR2*=1) vs. Not

		(1) Husband Hours	(2) Wife Hours	(3) Husband Wage	(4) Wife Wage	(5) Husband Earnings	(6) Wife Earnings
Fixed Effects	*AFTER*	72	-1099	.11	-.24	4949	-7212
	(t)	(1.8)	(24)	(3.5)	(5.2)	(4.8)	(18.7)
	LP2 AFTER*	66	61	.01	.04	717	-77
	(t)	(1.6)	(1.3)	(.3)	(.9)	(.7)	(.2)
	N	17801	17801	17480	12913	17801	17801
	$\Delta(\Delta S)$	5		-.03		794	
Fixed Effects SUR	*AFTER*	64	-1090	.06	-.23	4212	-7021
	(t)	(2.3)	(34)	(2.4)	(7.0)	(5.8)	(26)
	LP2 AFTER*	70	50	.04	.04	1009	-219
	(t)	(1.3)	(.8)	(.8)	(.7)	(.7)	(.4)
	N	17801		12688		17801	
	$\Delta(\Delta S)$	19		-.002		1220	
	(p)	(.7)		(.97)		(.14)	

[a] *AFTER*: After the birth of the first child. Wage: (log of the real) hourly wage rate. Hours: annual hours worked. Earnings: (real) annual earnings. Controls include: dummies for year of age, years of education, year of observation and whether the first child was born in the year, and an interaction of *LIVEPAR2* with whether the first child was born in the year .

Appendix Table 1
Summary Statistics
Mean (Standard Deviation)

	Husband	Wife
Annual Hours of Work	2250 (697)	988 (871)
Real Hourly Wage (1983 dollars)	12.0 (9.5)	7.7 (9.2)
Real Annual Earnings (1983 dollars)	26158 (21513)	7412 (8839)
Years of Education	13.5 (2.3)	13.2 (2.1)
Age	32.9 (6.8)	30.8 (6.5)

After Child Born	.82
Wife Born Before 1950	.43
Wife Continuous Worker	.27
Couple Divorced within Sample Period	.09
First Child is a Boy	.53
Husband Lived with Both Parents while Growing Up	.86
Wife Lived with Both Parents while Growing Up	.84
Year	1983
Number of Couples	1240
Median Number of Years within Sample	14