GEOGRAPHIC MOBILITY OF SCIENTISTS: SEX DIFFERENCES AND FAMILY CONSTRAINTS*

KIMBERLEE A. SHAUMAN AND YU XIE

Women scientists are much more likely than men scientists to be in two-career marriages. This study examines the argument that the higher prevalence of two-career marriages among women scientists presents a significant impediment to their geographic mobility. Three hypotheses are developed and tested. First, scientists in two-career families are less likely to migrate than scientists in one-career families. Second, the effect of two-career marriages on the probability of migration differs with gender; women are affected more negatively. Third, the effect of children on the probability of migration differs with gender; women are affected more negatively. The empirical work uses a data set of doctoral scientists extracted from the 5% Public Use Microdata Sample from the 1990 census. The first two hypotheses are not confirmed by the empirical results, but we find evidence supporting the third. Family constraints on women scientists' careers generally appear to be weak, but become acute when they have children.

Gender stratification in science is now a well-documented phenomenon (e.g., Ahern and Scott 1981; Etzkowitz et al. 1994; Fox 1995; Long and Fox 1995; Zuckerman 1991). The causes are not well understood, however. Extant research has established disparities between men and women scientists in structural locations, most clearly in two aspects. First, women scientists are less likely than men to be found in work settings that are most conducive to successful scientific and engineering careers. For example, academic women are more likely than men to be employed in teaching colleges rather than in research universities (Fox 1995:212; Long and Fox 1995).[1] Second, women scientists and engineers are promoted to advanced ranks and positions more slowly than men (Ahern and Scott 1981; Cole 1979, table 6-5; Long, Allison, and McGinnis 1993; Peek 1995).

Observation of these gender differences in structural locations (Rosenfeld 1991) has generated a dominant approach to understanding sex differences in career outcomes, namely the "structural approach." Structural explanations posit the existence of formal and informal mechanisms by which women and men scientists are sorted into different positions and receive access to different career opportunities. Although this theoretical approach has proved powerful in explaining the consequences of gender stratification (e.g., Bayer and Astin 1975; Xie and Akin 1994), research based on the structural approach has failed thus far to explain the sorting mechanisms it postulates—that is, to show *how* and *why* women and men are allocated to different structural positions (Blau 1984).

A similar problem exists in studies of sex differences in earnings: Although a large fraction of such sex differences is known to be attributable to "the existence of a sex-segregated labor market and associated wage structure," further research is needed to study "the process by which individuals are sorted into different positions within the wage structure" (Marini 1989:374). Yet the similarity of these two instances of gender inequality itself does not engender parallel explanatory frameworks. Studies that attempt to account for gender differences in earnings within specific occupations have focused on gender differences in individual-level characteristics such as human capital (Polachek 1981) and career ambition (Turner 1964). In the scientific labor market, however, there are good reasons to discount these two individual characteristics as causes of sex stratification. Both human capital investment and career ambition are likely to be high among all scientists, regardless of sex. Obtaining the necessary credentials for a scientific career (which normally include a doctoral degree) is an arduous task. Women who make this kind of human capital investment are self-selective, and are comparable or even superior to their male counterparts in "intellectual caliber and academic performance" (Zuckerman 1991:34).

As suggested by Sonnert and Holton (1996), the independent explanatory power of the structural and individual approaches appears to be limited, but the potential interaction effects between structural factors and individual characteristics merit further investigation. In this paper we attempt to test the effects of such an interaction. Our approach follows the tradition in two streams of research: the sociological and social psychological literature on dual-career constraints on academic careers (e.g., Marwell, Rosenfeld, and

*Kimberlee Shauman and Yu Xie, Population Studies Center and Department of Sociology, University of Michigan, Ann Arbor, MI 48109-1382; e-mail: kima@umich.edu or yuxie@umich.edu. This research was supported by a research grant and a Young Investigator Award from the National Science Foundation to Yu Xie, and by an NICHD traineeship to Kimberlee Shauman. An earlier version of this paper was presented at the 1995 meetings of the Population Association of America, held in San Francisco. The authors are grateful to William Frey, Robert Mare, and anonymous reviewers for advice and comments, and to Albert Anderson and Cathy Sun for programming assistance. The opinions expressed herein are those of the authors.

1. Zuckerman (1991:35–36) maintains that women are no less likely than men to be located in more prestigious research institutions, but Long and Fox reject Zuckerman's claim in their recent review (1995:51).

Spilerman 1979) and the economic and demographic literature on family migration decisions and patterns (e.g., Mincer 1978). Researchers in these areas have suggested that married women's inability to initiate a family move may harm their career advancement because it may preclude them from taking advantage of some career opportunities. More specifically, Marwell et al. (1979) propose the following explanation of how gender stratification is produced in the academic labor force:

> [A] considerable part of the disparity between men and women in academic status and earnings derives...from the disadvantages that marriage imposes on the women. In a two-career family many crucial decisions (for example, whether or not to have children and where to reside) can have an adverse effect on one or both careers. In this situation, two-career couples will be at a handicap, in comparison with one-career couples, with respect to maximizing job prospects. We will argue that, in the aggregate, in academia women's careers suffer more as a result than men's. (p. 1225)

Similarly, Mincer (1978) suggests a causal link between the migration of dual-career families and the progress of women's careers:

> By interrupting the continuity of women's work, tied migration leads to slower growth of wages over the life cycle. The adverse effect on wage growth can occur even without discontinuity of employment....Tied migration ranks next to child rearing as an important dampening influence in the life-cycle wage evolution of women. (p. 771)

Drawing on these two lines of research, we formulate the hypothesis that women scientists are disadvantaged relative to men because women scientists are geographically less mobile. We call this hypothesis the "differential mobility" thesis.

The differential mobility hypothesis rests on two assumptions: first, that geographic mobility has a positive effect on career advancement; second, that two-career couples are less able than one-career couples to make long-distance moves. On the basis of these two assumptions and the observation that married women scientists are more likely than their male counterparts to belong to two-career couples, we hypothesize that women scientists are less likely to migrate across labor market boundaries.

In extending the differential mobility thesis to explain sex differences in career outcomes among doctoral scientists, we make two criticisms of the theoretical basis of this argument. First, previous research (Marwell et al. 1979; Mincer 1978) assumes too literally that two-career couples are less mobile than one-career couples. Empirical support for this assumption is limited by an inadequate identification of dual-career couples, a narrow focus on the restraining effects of dual-career marriage, and a lack of attention to the conditions under which dual-career marriages may increase family mobility. Second, studies of family migration and of the impact of career involvement on the propensity to move have treated married men and women symmetrically, and in doing so have not fully explored the implications of gender roles within the family.

Hence we refine the differential mobility thesis in four ways. First, we extend it to gender stratification in science.[2] Second, we subject to empirical test the assumption that two-career families are less mobile than one-career families. Third, we test possible interactive effects between marriage type and gender. Fourth, we introduce the sex-specific effects of children on family migration. We also replicate the finding that women scientists are more likely than men to reside in large labor markets in order to satisfy the locational demands of dual-career marriages. The empirical work is based on the 5% Public Use Microdata Sample (PUMS) from the 1990 census, the first U.S. census that collected valuable information on attained degrees.

THEORETICAL ISSUES

The Scientific Labor Market, Geographic Mobility, and Career Advancement

The market for doctoral scientists displays many structural characteristics that Ladinsky (1967) identifies with high levels of geographic mobility. Doctoral scientists typically occupy salaried positions in decentralized work settings where the ratio of managers to managed workers is low. Scientists are not subject to standardized work conditions, pay rates, or state licensing regulations. In addition, they tend to have "strong occupational communication networks" fostered by nationally circulated scholarly journals and other periodicals, national funding institutions, and professional organizations. All of these characteristics contribute to the national scope of the scientific labor market and hence to high long-distance migration rates among scientists.

The national scope of the labor market for doctoral scientists has implications for individual scientists' career development. Although scientists can advance their careers by being mobile, they also can suffer from an unwillingness or inability to move. According to Markham and Pleck (1986: 122), in a national market "mobile workers can compete for more positions, and they accumulate experience more rapidly as they move from job to job." In addition, economic reasoning from the human capital and crowding perspectives suggests that low-mobility workers may face more competition for positions and hence higher unemployment and lower wage rates. Thus the differential mobility thesis is highly relevant to doctoral scientists because of their distinctive quality as members of national labor markets.

Dual-Career Couples and Geographic Mobility

Overall, women scientists are less likely to be married than men scientists. Among married scientists, women are much more likely than men to be married to other scientists and other highly educated professionals, largely because of

2. This hypothesis has been proposed independently in the literature (e.g., Etzkowitz et al. 1994:54) but has not been subjected to empirical test.

hypergamous marriage patterns and gender differences in labor force participation in U.S. society. Because women are likely to marry men of their own or higher social status, highly educated career-oriented women tend to marry partners with at least equal educational attainment and career aspirations. Furthermore, because proportionally fewer women than men in the U.S. population have such characteristics, the supply of career-oriented women is not sufficient to match similar men. Consequently, women scientists are more often situated in dual-career families in which both partners are highly committed to their careers. Men scientists are less likely to be part of dual-career couples; among those who are, their wives' careers are likely to be less advanced than their own (Rosenfeld and Jones 1987:494). If two-career marriages impede scientists' geographic mobility, the gender difference in marriage patterns implies that married women scientists are affected more often than their male counterparts.

Mincer (1978) suggests that living in large urban areas with diversified labor markets reduces the degree to which both partners in a dual-career marriage must compromise their individual gains from migration. In a study of the geographic constraints experienced by dual-career families, Frank (1978) finds a higher probability of living in large urban areas among female professionals than among male professionals; this finding is consistent with the reasoning that large urban markets are more likely to satisfy the career needs of both partners in a dual-career marriage. This assertion is echoed by Marwell et al. (1979), who also argue that living in large labor markets increases the likelihood that both partners in a dual-career couple will find satisfactory jobs.[3] Using data from a 1969 survey of college and university faculty members, Marwell et al. show clearly that married academic women are much more likely than married academic men to be located in large metropolitan areas. (The population size of a metropolitan area is only a proxy for the size of the local labor market and not necessarily an accurate proxy for scientists. For our study, we use two different summary statistics that are intended to measure the general labor market as well as the scientific labor market.)

In addition to hypothesizing that women are more likely than men to live in large cities, Marwell et al. (1979) maintain that academic women are less geographically mobile than academic men because more women than men are constrained by dual-career marriages. In such a marriage, an individual partner may not be able to act on an opportunity that demands geographic relocation because it would disrupt the spouse's career. Implicit in the argument that women's career mobility is hampered by of depressed geographic mobility is the assumption that the partnership of two career-oriented individuals necessarily reduces the geographic mobility of such families. Otherwise it would be illogical to infer that women professionals are less mobile than men solely because the former are more likely than the latter to be in dual-career marriages. This assumption seems to be supported by extant studies of the influence of women's labor force participation on family migration patterns (Bird and Bird 1985; Duncan and Perrucci 1976; Lichter 1980, 1982; Long 1974; Mincer 1978). In general, women's labor force participation is found to depress the rate of family migration.

These findings are inconclusive at best, however, because they do not directly address migration rates of *dual-career* families. The problem is that past studies typically included no detailed information about spouses' education or occupation. In these studies, married women were compared with married men; the presence of a working wife was considered a proximate indicator of a dual-career union. Thus no serious attempt has been made to test the differential mobility thesis on individuals whose careers may require geographic mobility for advancement. To address this problem, we attempt to differentiate dual-career couples by using information about both spouses' degree attainment, employment status, and occupation.

Past demographic studies of family migration and women's employment also erred in overlooking the possibility that two careers in a family may generate more career-related opportunities for migration: Two careers in a family may generate more *per-family* career-related opportunities that require migration, although dual-career constraints may diminish the *per-career* realizations of such opportunities. Recognizing this possibility, we subject to empirical test the assumption that dual-career couples are less mobile than one-career couples. Our reasoning does not necessarily contradict the conventional wisdom that dual-career marriages constrain mobility, because migration rates for individuals in dual-career marriages would be much higher than those in single-career situations if no dual-career constraints existed. Let us demonstrate more analytically the proposition that dual-career families have increased opportunities to migrate.

For any geographical area, let n_{1f} and n_{1m} denote respectively the numbers of professional women and men in one-career families, and let n_{2f} and n_{2m} respectively denote the numbers of professional women and men in two-career families. Our definition of a one-career family includes unmarried professionals and professionals married to spouses whose careers typically do not require geographic mobility (e.g., homemaking). By definition, $n_{2f} = n_{2m} = n_2$. For simplicity, let us assume that all migrations are induced by considerations of career advancement, because this ideal typical situation illustrates our argument clearly. We let m_{1f} and m_{1m} denote respectively the numbers of career-induced migrations among n_{1f} and n_{1m}. For professionals in two-career families, we distinguish migrations induced by the wife's career (m_{2f}) or by the husband's career (m_{2m}). The total number of migrations experienced by two-career professionals is thus $m_{2f} + m_{2m}$.[4] Finally, let r_{1f}, r_{1m}, and r_2 denote the migration

3. Rosenfeld and Jones (1987:495) further postulated that even single academic women may prefer to live in large cities "because it is there that a suitable pool of potential mates and social partners exist."

4. For convenience we ignore moves that are initiated simultaneously by both spouses. This assumption is a reasonable because the probability of such occurrences at any given time should be small.

rates among one-career women, one-career men, and two-career couples. At the level of the family,

$$r_{1f} = m_{1f} / n_{1f}. \quad (1)$$

$$r_{1m} = m_{1m} / n_{1m}. \quad (2)$$

$$\begin{aligned} r_2 &= (m_{2f} + m_{2m}) / n_2 = m_{2f} / n_2 + m_{2m} / n_2 \\ &= m_{2f} / n_{2f} + m_{2m} / n_{2m} \\ &= r_{2f} + r_{2m}, \end{aligned} \quad (3)$$

where $r_{2f} = m_{2f} / n_{2f}$ and $r_{2m} = m_{2m} / n_{2m}$ are females' and males' career-driven migration rates among two-career professionals at the individual level rather than the family level. It can be shown that two-career families may experience higher mobility rates than one-career families, even though at the individual level it is true that dual-career constraints reduce the likelihood of career-driven migration for professionals in two-career families.

For simplicity, let us assume gender homogeneity,

$$r_{1f} = r_{1m} \text{ and } r_{2f} = r_{2m}. \quad (4)$$

Given eq. (4), professionals in two-career families are no less mobile than professionals in one-career families insofar as the reduction due to dual-career constraints is no more than half (i.e., $r_{2f} > 0.5\, r_{1f}$, or $r_{2m} > 0.5\, r_{1m}$). The reason, of course, is that two careers in a family generate two sets of career-related opportunities for migration.

Eq. (3) clearly contradicts Mincer's (1978) assertion that families with two working spouses are less likely to move than single-earner families. Mincer gives a simple example as an illustration, assuming independence between the husband and the wife in the propensity to move: If the average probability of a geographic move is 16% for both men and women, only 2.56% ($100 \times 0.16 \times 0.16$) of all families will migrate with no conflicts. As Mincer also realizes, however, only 70.56% ($100 \times 0.84 \times 0.84$) of all families will stay with no conflicts; in the remaining 26.88% of families, one spouse is better off migrating, while the other is not. Mincer's simulation, based on a parametric (i.e., bivariate normal) assumption for latent tendencies, reveals that a family's probability of moving is always less than that of an unmarried individual (or, in the best scenario, equal).

Mincer's conclusion should be interpreted cautiously, however, because other plausible specifications can yield vastly different results. For example, if the cost of moving is negligibly small in relation to the potential gain—that is, if the migration decision is dominated by gains rather than by costs—the presence of two working spouses will substantially increase the probability of migration. In a notation similar to Mincer's,

$$G_2 = G_{2m} + G_{2f} \geq G_{2m};$$

$$G_2 = G_{2m} + G_{2f} \geq G_{2f},$$

insofar as G_{2m} and G_{2f} are nonnegative, where G_2 is the net gain of migration for the family, G_{2m} is the net gain of migration for the husband, and G_{2f} is the net gain of migration for the wife. If we were to accept this unrealistic but illustrative assumption, all the remaining 26.88% of families in Mincer's example would migrate, increasing the propensity of migration from 16% for unmarried individuals to 29.44% for families with two working spouses.

Now let us turn to the implications of eq. (4). The assumption is tantamount to the proposition that women with stocks of human capital equal to those of their husbands command a fully competitive role in migration decisions related to career advancement (Duncan and Perrucci 1976). Researchers, however, have called into question precisely this assumption of gender symmetry within the family. In the context of studying the migration of academics, Marwell et al. (1979:205) argue that gender roles and the implicit hierarchy of career importance within marriage also impede women's career development. That is to say, the husband's career is usually considered primary even in dual-career families; hence migrations are more likely to be governed by opportunities associated with the husband's career than by those associated with the wife's career. In the notation of eq. (3), $r_{2f} < r_{2m}$. A sizable body of empirical research supports the notion that gender inequality exists within dual-career families. For example, neither the prestige of the wife's occupation nor the proportionate size of her contribution to the total family income is found to significantly affect family migration behavior (Duncan and Perrucci 1976; Lichter 1980, 1982; Long 1974; Shihadeh 1991).

The difficulty of understanding the asymmetry between husband's and wife's career interests is most evident in the contradictory interpretations of the role of careers in the migration literature. Although it is commonly accepted that career interests often prompt men to migrate, it is assumed that women in professional careers resist mobility because they wish to retain their current employment situation (Lichter 1980, 1982; Long 1974; Mincer 1978).

We find this differential treatment of male and female behavior unsettling and in need of an explanation. As indicated by eqs. (2) and (3), whether a wife's professional career decreases or increases a family's propensity for migration is a complicated issue involving the trade-off between the *addition* of opportunities associated with the wife's career and the *reduction* in the husband's mobility due to dual-career constraints. That is, a spouse's career decreases mobility only if the following inequality holds true:

$$r_2 < r_{1m} \Leftrightarrow r_{2f} + r_{2m} < r_{1m} \Leftrightarrow r_{2f} < r_{1m} - r_{2m}; \quad (5a)$$

$$r_2 < r_{1f} \Leftrightarrow r_{2f} + r_{2m} < r_{1f} \Leftrightarrow r_{2m} < r_{1f} - r_{2f}. \quad (5b)$$

Although results from past research are consistent with eq. (5a) (e.g., Duncan and Perrucci 1976; Lichter 1980, 1982; Long 1974), they may be attributable to the patent sex segregation of the labor force. That is, women are concentrated in female-dominated jobs, which tend to have short career ladders and not to require geographic mobility. Among women doctoral scientists, however, the situation can be quite dif-

ferent. For them, the job market is truly national, and career advancement often requires geographic relocation. Thus we apply the case of doctoral scientists to eq. (5) in order to test the first hypothesis of our study:

Hypothesis 1: Scientists in two-career families are less likely to migrate than scientists in one-career families.

Given the possible influence of within-family gender inequality, we further relax the assumption that two-career marriages have the same effect on women scientists as on men scientists. For example, being part of a two-career marriage may affect women's geographic mobility but not men's. This scenario corresponds to the situation in which eq. (5b) is true while eq. (5a) is false. Testing this possibility requires differentiation of the gender-specific effects of two-career marriages on migration. Therefore we will examine the interactive effects between marriage types and gender in order to test our second hypothesis:

Hypothesis 2: The effect of two-career marriages on the propensity of migration differs with gender; women are affected more negatively.

Family Structure and Geographic Mobility: The Effect of Children

Parenthood is widely believed to affect the careers of men and women scientists differently, placing an extra burden on women but having neutral or positive effects on men. As indicated by Zuckerman's (1991:52–53) review, however, empirical evidence taken as a whole has not supported the notion that child rearing impairs scientists' job performance (Cole 1979; Cole and Zuckerman 1987). One exception is a study by Hargens, McCann, and Reskin (1978), who report that having children has a negative effect on research productivity. That study, however, does not find an interaction effect between parent status and the researcher's gender. Differential effects of parenthood for men and for women scientists have yet to be established.

By focusing on the influence of marital status, Marwell et al. (1979) incorporate only one of the full array of personal characteristics that may be expected to interact differently for men and for women with the structure of the scientific labor market. We propose that the presence of children —more precisely, the presence of children of specific ages —may affect men and women scientists' careers differentially through its gender-specific effect on geographic mobility. Our proposal is motivated by the life-course explanation of family migration patterns, which suggests that married individuals with children are less likely to move than either single people or those who are married but have no children in the household (DaVanzo 1977; Mincer 1978; Sandefur 1985; Speare 1970).

Although we recognize the constraining effects of children on the migration of all scientists' families, we expect such effects to differ between men and women scientists. Our expectation for interaction effects between gender and children is supported by gender role theory, which provides a framework for recognizing the different behavioral expectations that society imposes on men and on women who occupy the same social statuses and life-course positions. Even when the partners in a dual-career marriage are equally committed to their careers, the arrival of children may cause a division of family duties that enforces traditional gender roles; the socially expected role for a woman is that of primary caregiver, and she will most likely assume this role and subordinate her other nonfamilial roles (Epstein 1974; Maret and Finlay 1984; Sorensen 1983; Spenner and Rosenfeld 1990; Stockard and Johnson 1980).

In interviews with a small number of couples in which both partners were heavily invested in their corporate careers, Hertz (1986) found that gender roles become a conspicuous force in the marriage only when child rearing is undertaken. Although these couples did not rely on traditional roles and divisions of labor to make their dual-career marriages successful,

> ...gender becomes a salient issue once children arrive: someone has to be with them. Women are still viewed by these couples as better equipped to nurture young children even though their lives until this point have paralleled those of their male peers and husbands. (p. 145)

After the birth of their first child, the majority of the women interviewed by Hertz reported decreasing their work hours and level of responsibility from those which they had maintained at their job before they had children. The effect of children on these dual-career families was to disrupt the career equity the couples had enjoyed, negatively affecting the women's careers but having little influence on the careers of their male partners. Hence we wish to test a third hypothesis in this research:

Hypothesis 3: The effect of children on the propensity to migrate varies with gender; women are affected more negatively.

The effect of children on family migration depends on the children's age to a more significant degree than on the number of children present in a family. Long (1972) found that the age composition of the children in a family has a consistently differential effect on family mobility, once the age of the household head is controlled: Families with only preschool-age children (0–6) are the most mobile; families with only school-age children are the least mobile; and families with both preschool- and school-age children fall between these two extremes, but their behavior more closely resembles that of the families with only school-age children. Families with only young children are more free to move because their children are not yet involved in a particular school district; thus the parents have fewer social ties to any one place. The opposite is true of families with school-age children. The social and emotional costs of migration increase substantially for their parents because children's participation in schools tends to increase parents' involvement in their community. As Long speculates, "Perhaps families with school-age children feel that transferring their children from one school district to another is, as a rule, undesirable"

(p. 374). This common conception is supported by empirical research documenting the detrimental effect of residential mobility on school achievement (Astone and McLanahan 1994; Coleman 1988; Haveman, Wolfe, and Spaulding 1991).

DATA

For this study we use a data set of scientists drawn from the 1990 census 5% PUMS. We define scientists as U.S. citizens who have attained a doctoral degree, currently are not in school, and report having an occupation that falls into one of five broad science categories: life science, physical science, social science, mathematics, and engineering.[5] We constructed these categories by collapsing three-digit census occupational codes. (See the appendix for a more detailed list of the categories.) We first selected from the PUMS those individuals who fit our definition; then we linked to each of their records information from the records of their spouse and children, if these family members were present at the time of the census. Because linking was possible only for family members living in the same household, our variables concerning spouse and children refer to spouse and children living in the same household as the scientist. In brief, our data set consists of parallel information for each scientist and for his or her spouse, and information about the presence and ages of the children of each scientist.[6]

Migration information for each scientist and spouse is based on a classification of geographic areas that we created to approximate local labor markets. To construct this classification, we used the Public Use Micro Areas (PUMAs) of residence in 1985 and 1990. PUMA is the most highly detailed geographic identifier available in the PUMS. The PUMA classification, however, tends to divide locales without regard for their economic and social cohesiveness. To more closely represent local labor markets, we collapsed adjacent PUMAs within a metropolitan area.[7] We define a migration between 1985 and 1990 as a move across the geographic areas thus defined. To be considered movers, scientists could have moved across state boundaries or could have moved from one geographic area to another within a single state. Those who reported a change of residence but who moved within the boundaries of a defined geographic area are considered nonmovers.

Marital Type is a five-category classification referring to the scientist's marital status and the spouse's educational and occupational characteristics. The marital-type categories are unmarried scientists, scientists who are married to other scientists, scientists who are married to nonscience doctorates, scientists who are married to other professionals, and scientists who are married to others. Unmarried scientists include never-married, separated, divorced, and widowed scientists.[8] The "other professionals" category includes spouses with master's and advanced professional degrees. The last category, "others," refers to all remaining spouses, including those out of the labor force in 1990. We define all married scientists as part of dual-career couples except those who fall into the "married to other" category.

Kids is a set of binary variables representing the presence of children of specific ages. The age categories we use are 0–6 (preschool), 7–12 (elementary school), and 13–18 (teens). Additional control variables are the scientist's field of specialization, the scientist's age, and a dichotomous classification of sector of employment. As a further control, we include in this analysis a continuous variable coded as the age of the scientist's spouse less the scientist's age, with unmarried scientists assigned a value of 0; positive values of this variable indicate that the scientist is younger than his or her spouse.[9]

RESULTS

Descriptive Results

Descriptive statistics in Table 1 document the differences between male and female scientists by field and marital type. In 1990 women account for 25% of all science doctorates in the labor force. Women scientists are well represented in the social and life sciences but severely underrepresented in engineering and the physical sciences. Gender differences in marriage types are also apparent. The gender gap in scientists' nonmarriage rates is no longer as striking as it was in the 1960s and 1970s (Xie 1989, table 1.11). According to our 1990 census data, 39% of women scientists are currently unmarried, compared with 19.4% of men. Gender differences in marriage patterns are also clear among married scientists. Women are much more likely to be married to fellow scientists (12.9%) and to other

5. The occupation measure was taken in 1990, at the end rather than the beginning of the interval within which a migration may have taken place. This is an unfortunate limitation common to all migration research using census data. We exclude scientists who are currently enrolled in school, however; because occupation is a relatively stable characteristic after the completion of formal education, we suspect that our results do not suffer much from this limitation.

6. When both husband and wife are doctoral scientists/engineers, their records are essentially duplicated, one with the husband as scientist/engineer, and the other with the wife as scientist/engineer. The nonindependence between the individuals in these scientist-scientist couples results in underestimated standard errors. This non-independence, however, should not produce biased parameter estimates in the multivariate analysis if the models are specified correctly.

7. We thank William Frey for advice and consultation on the creation of the coding scheme for geographic areas. When a PUMA consists of two or more metropolitan areas, or a combination of metropolitan and nonmetropolitan areas, we classify it as part of the largest metropolitan statistical area/primary metropolitan statistical area (MSA/PMSA). Completely rural PUMAs are retained according to the original PUMA codes.

8. We acknowledge the problem of collapsing never-married persons with those whose marriages have been terminated either through separation or divorce, or through the spouse's death. Changes in marital status, such as the transition from married to separated or divorced, have been found to increase the mobility rates of individuals, especially women (Speare and Goldscheider 1987; Speare, Goldstein, and Frey 1975). We found, however, that the migration behavior of divorced and separated scientists was similar to that of never-married scientists.

9. The assignment of 0 to unmarried scientists is innocuous in our multivariate analyses because there is a dummy variable for marital status that uniquely identifies unmarried scientists as a group.

TABLE 1. PERCENTAGE DISTRIBUTION OF SCIENTISTS BY MARITAL TYPE, FIELD OF SCIENCE, AND SEX

Scientists	Unmarried	Married to Scientist	Married to Nonscience Doctorate	Married to Other Professional	Married to Other	(*n*)
Males	19.38	4.26	4.60	27.65	44.11	(5,851)
Life scientists	20.37	2.82	6.63	23.80	46.38	(815)
Physical scientists	18.35	3.47	4.60	25.98	47.60	(1,586)
Social scientists	21.20	7.30	4.45	31.74	35.31	(1,821)
Mathematical scientsts	22.53	6.48	5.46	31.06	34.47	(293)
Engineers	16.84	1.42	3.37	25.67	52.69	(1,336)
Females	39.04	12.93	10.88	21.70	15.45	(1,903)
Life scientists	42.71	12.20	12.88	20.68	11.53	(295)
Physical scientists	33.00	20.20	15.27	14.78	16.75	(203)
Social scientists	39.20	11.71	8.45	23.82	16.81	(1,255)
Mathematical scientsts	42.11	14.47	18.42	11.84	13.16	(76)
Engineers	35.14	14.86	24.32	18.92	6.76	(74)

nonscience doctorates (10.9%) than are their male counterparts (4.3% and 4.6% respectively). Women scientists are less likely than men scientists to be married to other professionals, the category that includes spouses who hold a master's or professional degree. These statistics reflect the pattern of hypergamy among the women scientists: They are less likely to marry men of lesser educational attainment than their own. If we consider as two-career marriages these three types of marriages in which both marriage partners have attained advanced degrees, women clearly are much more likely than men to be in dual-career couples (45.5% versus 36.5%). Conversely, men are much more likely than women to be married to nonprofessionals (44.1% versus 15.5%). These descriptive results corroborate our earlier assertion that a smaller fraction of male scientists than of female scientists live in two-career families.

Confirming Marwell et al.'s (1979) earlier finding, men and women scientists differ in the kind of geographic areas where they live as characterized by the local labor market size in 1990. In the separate panels of Table 2 we present two measures of the labor market size in the areas where scientists live: the total size of the population and the size of the scientific population. These statistics show that women are less likely than men to live in nonmetropolitan areas and significantly more likely to live in larger metropolitan areas, as well as in areas where large numbers of other scientists live. The chi-square statistic for each panel indicates that the differences are statistically significant. These descriptive statistics support the argument that women are more likely than men to live in urban areas with large labor markets. However, we did not find a significant association between marital status and the size of the labor market in the area where scientists live.

In Table 3 the marginal distributions of explanatory variables, along with migration rates, are presented separately for male and for female scientists. Female scientists are on average younger than male scientists, and more likely to be childless and to have children age 6 and younger in 1990. Men scientists are more likely than women to have children over age 6. These gender differences in family composition, however, are partly an artifact of the relative "youth" of the population of women scientists; that is, on average women scientists belong to more recent cohorts than men. Age differences between scientists and their spouses are almost perfectly reciprocal between men and women: Male scientists are married to women who are, on average, 2.3 years their junior, and the women scientists' husbands are, on average, 2.3 years their senior. Women and men scientists are equally likely to be employed in the academic sector.

Migration rate is the proportion of scientists who reported a move during the period between 1985 and 1990. In Table 3 we observe that in the aggregate, women are slightly more likely to have moved during the five years preceding the 1990 census: 31% of the women and 28% of the men reported undertaking a move during that period.

Marital type and field of science appear to affect migration rates somewhat independently of gender. Unmarried scientists have the highest migration rates of all marital types. Scientists who are married to nondoctorate professionals

10. The mobility rates for married scientists are slightly inflated because census data lack information about the sequence of marriage and migration during the retrospective five-year period. For those who reported being married in 1990, there is no way to determine whether they were married in 1985. Because single individuals are more likely to migrate than those who are married, our inability to identify clearly marital status at the time of a move inflates the mobility rate of those scientists who report being married in 1990. To assess the degree to which this may be a problem, we calculated the proportion of married scientists whose long-distance moves were identical in both origin and destination. This proportion was very high (90.1%), an indication that most of the moves we observe were joint moves at the family level.

TABLE 2. JOINT DISTRIBUTIONS OF SCIENTISTS BY SEX, SIZE OF TOTAL POPULATION, AND SIZE OF SCIENTIFIC POPULATION IN GEOCODE OF RESIDENCE IN 1990

	Percentage Distribution	
	Males	Females
Size of Population		
Nonmetropolitan	6.36	6.15
Metropolitan		
Fewer than 1 million	33.21	27.38
1 million to 2 million	20.32	20.44
2 million or more	40.11	46.03
Pearson chi-square (df)	27.58 (3)***	
Size of Scientific Population		
Fewer than 5,000	40.30	34.42
5,000 to 9,999	14.84	15.45
10,000 to 14,999	16.01	16.13
15,000 or more	28.85	34.00
Pearson chi-square (df)	25.80 (3)***	
(*n*)	(5,851)	(1,903)

***$p < .001$

have the lowest overall mobility rates.[10] Life scientists and physical scientists tend to have the highest mobility rates, whereas social scientists have relatively low migration rates.

In agreement with the literature on migration, we also find higher mobility rates among scientists with no children or children of preschool age (0–6) than among those with teenage children. In addition, the negative effects of having children seem stronger for women than for men.[11] The significance of this interaction effect is explored more fully in a multivariate analysis.

The statistics in Table 3 document a strong relationship between scientists' age and the mobility rate. This effect is very significant, as is expected on the basis of the U.S. migration literature (Long 1988). Younger scientists are more likely to have made at least one long-distance move during the period 1985–1990, regardless of gender. Sector of employment also appears to have a significant effect on women scientists' migration. Contrary to the findings of Marwell et al. (1979), it appears that in 1990, women academic scientists were significantly more likely than men academics to have migrated during the previous five years.

11. Gender differences in the effects of children may be underestimated in our analysis because we cannot identify and include women scientists who withdraw from the labor force and thus report no occupation. Because we rely on occupation to identify individuals as scientists, and because women are more likely than men to withdraw from the labor market, especially in conjunction with childbearing, it is possible that this analysis misses a nontrivial proportion of women scientists.

TABLE 3. PERCENTAGE DISTRIBUTION AND MIGRATION RATES OF SCIENTISTS BY SEX AND OTHER EXPLANATORY VARIABLES

	Percentage Distribution		Migration Rates	
	Males	Females	Males	Females
Total Sample			0.28	0.31*
Scientist's Age				
25–29	2.55	4.73	0.84	0.57***
30–34	10.27	16.92	0.64	0.59
35–39	17.89	21.28	0.40	0.37
40–44	22.00	24.75	0.24	0.22
45–49	22.12	17.08	0.16	0.16
50–54	14.85	9.51	0.12	0.12
55–59	10.32	5.73	0.12	0.10
Field				
Life sciences	13.93	15.50	0.34	0.38
Physical sciences	27.11	10.67	0.31	0.44***
Social sciences	31.12	65.95	0.25	0.26
Mathematical sciences	5.01	3.99	0.24	0.37*
Engineering	22.83	3.89	0.25	0.38*
Marital Type				
Unmarried	19.38	39.04	0.35	0.34
Married to scientist	4.26	12.93	0.32	0.30
Married to other nonscience doctorate	4.60	10.88	0.26	0.33
Married to other professional	27.65	21.70	0.25	0.24
Married to other	44.11	15.45	0.26	0.29
Children				
None	48.85	59.38	0.29	0.36***
Children age 0–6 present	24.56	23.91	0.36	0.29*
Children age 7–12 present	23.52	15.03	0.23	0.13***
Children age 13–18 present	20.73	11.19	0.14	0.14
Employment Sector				
Nonacademic	81.85	81.03	0.28	0.29
Academic	18.15	18.97	0.27	0.37***
Age Difference between Scientist and Spouse (Married Scientists Only)	−2.32	2.34		
(*n*)	(5,851)	(1,903)		

*$p < .05$; ***$p < .001$ (Significance levels refer to the Pearson chi-square testing for the hypothesis that the migration rate is the same across the sexes within a category.)

These descriptive results cast some doubt on our first hypothesis, that scientists in dual-career marriages are geographically more constrained than scientists in one-career marriages. Doctoral scientists married to other professionals with doctoral degrees are more, not less, mobile than those married to less professionally oriented spouses. That is, eq. (5) does not hold, at least for married scientists. Nor does the second hypothesis seem to be supported, because differentials by marriage type do not vary by sex. The results, however, are consistent with the third hypothesis, that women's migration rates are more constrained than men's by the presence of children. Yet the findings from Table 3 are preliminary in the sense that they may be contaminated by various confounding factors. For example, the women are younger than the men, more likely to belong to dual-career couples, and more likely to be social scientists. Accurate tests of these hypotheses must control for other factors that are relevant to the relationship between scientists' gender and their geographic mobility. Accordingly we turn to the results from a multivariate analysis using logit models.

Results from Logit Models

The estimated coefficients and goodness-of-fit statistics for an additive and an interactive model are presented in Table 4. The variables included in the additive model collectively have a strong explanatory power, as indicated by the chi-square statistic of 1,329 for 20 degrees of freedom for the model. The estimated coefficient for Sex in the additive model is not significantly different from 0; this finding indicates that, when we control for composition, women are no less likely than their male colleagues to have migrated during the period 1985–1990.

The other estimated coefficients for this additive model confirm the patterns found in the descriptive results. Younger scientists are significantly more likely than older scientists to be geographically mobile, and the age effect is monotonic. The coefficient of the age difference between spouses is estimated to be significantly negative, an indication that net of scientists' own age, the probability of moving is lower for scientists with older spouses. Because married women scientists are more likely to be younger than their spouses, whereas the reverse is true for men, this effect reduces women's mobility but enhances men's mobility.

Life scientists and physical scientists are the most likely to have migrated, and the propensity for migration is similar for the two groups. Social scientists are the least likely to have migrated; mathematical scientists and engineers are somewhat more likely.

The effect of children on the propensity to migrate is as predicted in the literature (Long 1972): Families without children are the most likely to migrate, followed by families

12. We focus our interpretation on the influence of children *before* the moves made by the scientists in our sample. Some of the children age 0–6 may have been born after a move made during the 1985–1990 period; hence our estimation of the effect of children age 0–6 may reflect, in part, migration among childless scientists. We cannot account for this source of pos-

TABLE 4. ESTIMATED COEFFICIENTS OF TWO LOGIT MODELS

	Additive Model		Multiplicative Model	
	β	SE(β)	β	SE(β)
Constant	1.336	0.202	1.309	0.203
Sex (Female)	–0.107	0.073	0.061	0.088
Scientist's Age				
25–29	(excluded)		(excluded)	
30–34	–0.470	0.165	–0.466	0.165
35–39	–1.357	0.161	–1.344	0.161
40–44	–2.066	0.164	–2.049	0.164
45–49	–2.630	0.169	–2.613	0.169
50–54	–3.072	0.182	–3.041	0.182
55–59	–3.196	0.194	–3.157	0.194
Field				
Life sciences	(excluded)		(excluded)	
Physical sciences	–0.066	0.092	–0.057	0.092
Social sciences	–0.327	0.086	–0.325	0.086
Mathematical sciences	–0.194	0.147	–0.190	0.147
Engineering	–0.262	0.101	–0.258	0.101
Age Difference between Spouses	–0.039	0.007	–0.038	0.007
Employment Sector				
Nonacademic	(excluded)		(excluded)	
Academic	–0.002	0.076	–0.003	0.076
Marital Type				
Unmarried	(excluded)		(excluded)	
Married to scientist	0.135	0.154	0.127	0.154
Married to other nonscience doctorate	–0.134	0.122	–0.159	0.123
Married to other professional	–0.068	0.120	–0.111	0.121
Married to other	0.062	0.124	0.015	0.125
Children				
None	(excluded)		(excluded)	
Children age 0–6 present	–0.200	0.073	–0.127	0.080
Children age 7–12 present	–0.211	0.076	–0.104	0.082
Children age 13–18 present	–0.389	0.091	–0.402	0.098
Sex (Female) × Children				
Sex × No children			(excluded)	
Sex × Children age 0–6 present			–0.312	0.150
Sex × Children age 7–12 present			–0.715	0.209
Sex × Children age 13–18 present			0.085	0.236
Model Chi-Square	1,328.50		1,348.01	
Degrees of Freedom	20		23	

with young children, but mobility declines significantly as children enter their teens.[12]

The coefficients for marital type in the additive model are particularly interesting. We find no significant difference in the probability of long-distance geographic mobility among scientists of any marital type. According to this model, the tendency to migrate among scientists in two-career families is no lower than among scientists in one-career families, nor is it lower than the migration rate for unmarried scientists. Thus we reject the first hypothesis.

To test whether the effects of any of the control variables differ between men and women, we entered the interaction between Sex and each of the other characteristics into the additive model. None of these interactions was significant except the interaction between Sex and Kids (see Akin and Xie 1995, table 3). The most theoretically important interactions are the interactions between Sex and Marital Type and between Sex and Kids.

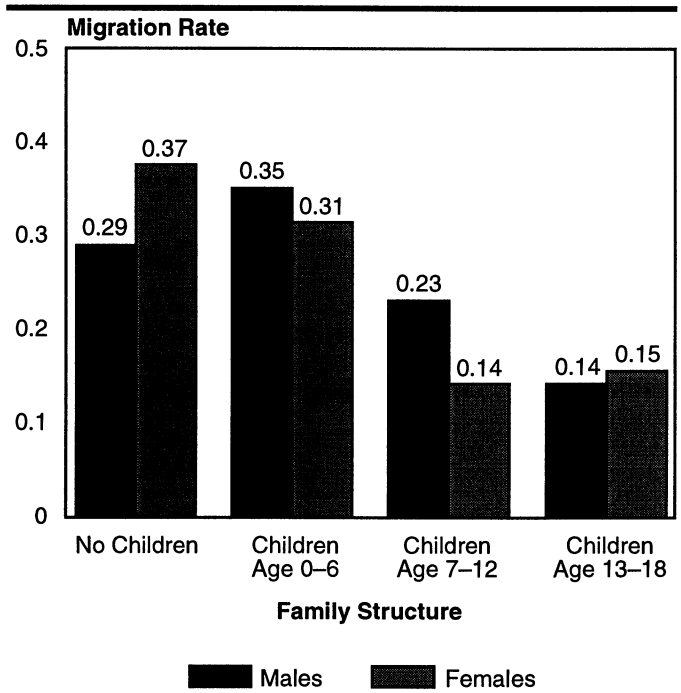
The inclusion of the Sex by Marital Type interaction directly tests the second hypothesis, that women and men are affected differently by marital type. The insignificance of this interaction, an increase in the model chi-square of 6.67 for 4 additional degrees of freedom, leads us to reject the second hypothesis in favor of its alternative, that the effects of marriage type are the same for men and for women.

The Sex by Kids interaction tests the third hypothesis, that the presence of children affects men and women differently. This hypothesis is confirmed: The inclusion of this interaction increases the model chi-square by 19.51 for 3 degrees of freedom over the additive model. The significance of this interaction indicates that the effects of children on scientists' mobility differ between men and women scientists. This interaction is detailed by the coefficients presented in Table 4 for Kids and for the Sex by Kids interaction in the interactive model.

Figure 1 portrays the effects of children on the mobility rates for male and for female scientists, with the other variables in the interactive model held constant at their sample means. For men, scientists with very young children are the most likely to have migrated, and those with teenage children are the least likely. The migration rate of men with teenage children is 61% less than the rate for men with children age 0–6. Neither preschool nor elementary-age children, however, have a significant effect on the migration rates of male scientists' families compared with those of childless scientists.

As shown in Figure 1, the adjusted migration rate of childless women scientists is greater than that of childless male scientists. For women, however, children have a significantly negative effect on mobility, regardless of the children's age. The effect of preschool and elementary-age children on women's geographic mobility is significantly negative; it depresses their mobility rates far below those of men in similar family structures. The gender gap in geographic mobility is the greatest for scientists with children age 7–12: Women scientists with children in this age group are 39% less likely to have migrated than men with children of this age. Among scientists with preschool children, women are 11% less likely to migrate than men. Among those with teenage children there is no significant gender gap: The mobility rate for such families is very low for both men and women scientists.

FIGURE 1. PREDICTED MIGRATION RATE FOR SCIENTISTS, BY SEX AND FAMILY STRUCTURE



DISCUSSION

Census data do not permit us to answer definitively why the effects of children on scientists' migration differ by sex. We propose, however, that this interactive pattern can be understood in the context of unequal burdens of childbearing and child rearing on working men and women, which can be manifested through differential responses in commitment to the labor force. Hertz (1986), for example, suggests that married women are affected by childbearing more strongly than their male colleagues because women tend to devote time to child care that they would otherwise have spent in pursuit of career mobility. To investigate whether this is the case in our sample of scientists, we examined the mean hours and weeks worked by men and by women scientists and their spouses. This information, along with the male-to-female ratios of weeks and hours worked by scientists and their spouses, is presented in Table 5. Our sample is potentially biased in the conservative direction because it excludes women who were out of the labor force in 1990; that is, our statistics may over-

sible bias because we lack information about the sequence of childbearing and migration events during the five-year period.

TABLE 5. MEAN HOURS AND WEEKS WORKED BY SCIENTISTS AND THEIR SPOUSES, BY SEX, MARITAL TYPE, AND FAMILY STRUCTURE

	Hours Worked by Scientist			Hours Worked by Scientist's Spouse			Weeks Worked by Scientist			Weeks Worked by Scientist's Spouse		
	Males	Females	M/F Ratio	Males	Females	M/F Ratio	Males	Females	M/F Ratio	Males	Females	M/F Ratio
Unmarried	43.81	42.21	1.04	n/a	n/a	n/a	49.91	48.65	1.03	n/a	n/a	n/a
Married to Scientist												
No children	44.24	41.66	1.06	41.31	44.11	0.94	50.19	48.30	1.04	47.71	50.44	0.95
Children age 0–6 present	44.80	31.15	1.44	29.35	44.59	0.66	49.88	44.12	1.13	44.08	49.83	0.88
Children age 7–12 present	44.45	39.19	1.13	39.19	45.07	0.87	49.00	48.41	1.01	48.45	49.00	0.99
Children age 13–18 present	43.00	37.94	1.13	37.45	43.97	0.85	51.15	47.20	1.08	45.73	51.11	0.89
Married to Other Nonscience Doctorate												
No children	47.04	41.10	1.14	39.71	45.58	0.87	50.49	47.66	1.06	42.86	47.91	0.89
Children age 0–6 present	46.52	30.30	1.54	31.20	44.81	0.70	50.24	45.43	1.11	39.77	50.79	0.78
Children age 7–12 present	45.60	32.43	1.41	30.42	49.30	0.62	51.05	45.98	1.11	38.15	51.68	0.74
Children age 13–18 present	44.30	36.38	1.22	36.11	46.50	0.78	51.41	46.82	1.10	41.34	50.76	0.81
Married to Other Professional												
No children	45.05	41.67	1.08	33.51	39.90	0.84	49.35	47.29	1.04	40.67	46.06	0.88
Children age 0–6 present	46.06	27.52	1.67	20.85	46.95	0.44	50.70	43.40	1.17	33.09	49.78	0.66
Children age 7–12 present	44.71	31.32	1.43	23.74	46.95	0.51	50.57	45.98	1.10	33.60	50.07	0.67
Children age 13–18 present	47.20	33.67	1.40	29.98	47.77	0.63	50.59	43.80	1.16	37.90	46.72	0.81
Married to Other												
No children	44.02	39.59	1.11	23.61	40.35	0.59	49.57	46.75	1.06	33.03	45.97	0.72
Children age 0–6 present	45.64	31.90	1.43	11.82	43.57	0.27	50.76	45.26	1.12	21.68	48.11	0.45
Children age 7–12 present	45.26	33.93	1.33	15.35	39.26	0.39	50.49	44.85	1.13	24.09	44.74	0.54
Children age 13–18 present	44.44	34.97	1.27	20.44	39.58	0.52	50.59	46.97	1.08	30.20	46.06	0.66

estimate the labor force attachment of all potential women scientists and thus *understate* sex differences.

Average hours worked per week for unmarried women are on a par with those reported for men. Among married scientists the smallest gender differences in hours worked are found for scientists who have no children present in the household. For these scientists, the male-to-female ratio of hours worked ranges from 1.06 for scientists who are married to other scientists to 1.14 for scientists who are married to other nonscience doctorates. The presence of children of any age increases the male-to-female ratio in hours worked; this pattern is true regardless of marital type. The ratios for scientists with preschool children range from 1.43 (for scientists who are married to others) to 1.67 (for scientists who are married to other professionals), an indication that women with very young children work about one-third as many hours as their male counterparts. The hours reported by women scientists do not fall below full-time on average; rather, men scientists are able to work more than 40 hours per week on average even when they have very young children. The gender gap in working hours narrows as the children's age increases, but it remains substantial even for those with teenage children.

We interpret this disparity as due in part to sex differences in the spouses' time commitment to childcare tasks. The descriptive statistics in Table 5 show that male scientists' wives substantially reduce their hours worked when a child is present. No such pattern exists for female scientists' husbands. As shown in the second column of Table 5, when children are present, male scientists' wives work fewer hours than do female scientists' husbands.

The third set of columns in Table 5 shows that sex differences in the number of weeks worked are affected less drastically by the presence of children, although the general tendency toward an interaction effect holds true. In addition, we see no apparent effect of children's age on sex differences in the average weeks worked. In part this is an artifact of our sample selection because the sample includes only scientists in the labor force. Nonetheless, the result is consistent with our argument that the presence of children has differential effects on men and on women scientists. Probably the impact on the ratio of hours worked in a week is greater than

on the ratio of weeks worked in a year because of women scientists' need to balance their commitment to working in science with their commitment to providing primary care for children.

CONCLUSION

The migration of dual-career families is interesting because it is a point at which gender dynamics are manifested and become observable through family behavior. Although geographic mobility is not the only route to career mobility, it is an important avenue for developing specific types of careers such as those in science. In migration for career enhancement, individual characteristics interact with the structural characteristics of a labor market. Future researchers must test the influence of structural characteristics empirically by comparing the family migration patterns of the incumbents of various labor markets. It will also be important to link the migration patterns of dual-career families with the subsequent career progress, costs, and benefits experienced by the individuals in such couples.

In this study we show that dual careers potentially generate more opportunities that require migration, although realization of such opportunities may be constrained. We find, however, that the mobility rates of dual-career families do not differ significantly from those of unmarried or single-career families. Thus our results do not support the notion that marital type accounts for gender differences in geographic mobility. We also fail to find that two-career marriages affect women more negatively than men.

We find clear evidence supporting the third hypothesis, that the presence of children limits women scientists' migration significantly more than that of men scientists. In our sample of doctoral scientists extracted from the 1990 census, women with children are less free to be geographically mobile than both women without children and men. In contrast, men exhibit more mobility when children are young; we have shown indirectly that this greater mobility among men is probably due to their wives' lesser labor force commitment and greater investment in child care, especially when the children are young. Men scientists' propensity to migrate becomes restricted as their children enter their teens; in this respect men scientists follow the family migration patterns of the general population (Long 1972). The timing of this restriction for men is likely to coincide with the middle years of career formation—that is, a period of career stability. However, women scientists' geographic mobility is restricted significantly when their children are young; we show that this is probably a result of their assuming the primary caregiver role. For women, this period of restricted mobility is likely to coincide with the early years of their careers. This is the time of career formation, when a lack of geographic mobility may be most detrimental to a scientist's future career mobility.

Our research helps to clarify how and why women and men come to occupy different structural positions in the scientific labor market. Restrictions on geographic mobility and on the ability to be a full-time participant in the labor market at an early career stage can have long-lasting negative consequences on women scientists' careers. Future research must examine the extent to which women's restricted geographic mobility and work commitment translate into lower rates of career mobility. We have demonstrated that the heavier restriction on mobility for women is due not to two-career marriages per se, but to women's greater responsibilities for child care. Perhaps the past debate on women scientists focused wrongly on the balance between maximizing their husbands' careers and maximizing their own careers. Our research suggests instead that as long as child care continues to fall on women's shoulders, the real dilemma facing the woman scientist is the choice between maximizing her own career and her responsibility for her children's well-being.

APPENDIX TABLE A1. 1990 CENSUS OCCUPATIONAL CODES FOR DEFINING SCIENTISTS AND ENGINEERS

Life Scientists	
077	Agricultural and food scientists
078	Biological and life scientists
079	Forestry and conservation scientists
083	Medical scientists
113	Earth, environmental, and marine science teachers
114	Biological science teachers
117	Natural science teachers, n.e.c.[a]
133	Medical science teachers
136	Agriculture and forestry teachers
Social Scientists	
166	Economists
167	Psychologists
168	Sociologists
169	Social scientists, n.e.c.
173	Urban planners
118	Psychology teachers
119	Economics teachers
123	History teachers
124	Political science teachers
125	Sociology teachers
126	Social science teachers, n.e.c.
Mathematical Scientists	
066	Actuaries
067	Statisticians
068	Mathematical scientists, n.e.c.
128	Mathematical science teachers
Physical Scientists	
069	Physicists and astronomers
073	Chemists, except biochemists
074	Atmospheric and space scientists
075	Geologists and geodesists
076	Physical scientists, n.e.c.
115	Chemistry teachers
116	Physics teachers

Engineers	
044	Engineer, aerospace
045	Engineer, metallurgical and materials
046	Engineer, mining
047	Engineer, petroleum
048	Engineer, chemical
049	Engineer, nuclear
053	Engineer, civil
054	Engineer, agricultural
055	Engineer, electrical and electronic
056	Engineer, industrial
057	Engineer, mechanical
058	Engineer, marine and naval architects
059	Engineer, n.e.c.
063	Surveyors and mapping scientists
127	Engineering teachers
258	Sales engineers

[a]n.e.c. = not elswhere classified.

REFERENCES

Ahern, N.C. and E.L. Scott. 1981. *Career Outcomes in a Matched Sample of Men and Women Ph.D.s: An Analytical Report.* Washington, DC: National Academy Press.

Akin, K. and Y. Xie. 1995. "Migration of Scientists: Roles of Gender and the Family." Research Report 95–350, Population Studies Center, University of Michigan.

Astone, N.M. and S.S. McLanahan. 1994. "Family Structure, Residential Mobility, and School Dropout: A Research Note." *Demography* 31:575–84.

Bayer, A.E. and H.S. Astin. 1975. "Sex Differentials in the Academic Reward System." *Science* 188:796–802.

Bird, G.A. and G.W. Bird. 1985. "Determinants of Mobility in Two-Earner Families: Does the Wife's Income Count?" *Journal of Marriage and the Family* 47:753–58.

Blau, F.D. 1984. "Occupational Segregation and Labor Market Discrimination." Pp. 117–43 in *Sex Segregation in the Workplace: Trends, Explanations, Remedies*, edited by B.F. Reskin. Washington, DC: National Academy Press.

Cole, J.R. 1979. *Fair Science: Women in the Scientific Community.* New York: Columbia University Press.

Cole, J.R. and H. Zuckerman. 1987. "Marriage, Motherhood and Research Performance in Science." *Scientific American* 25:119–25.

Coleman, J.S. 1988. "Social Capital in the Creation of Human Capital." *American Journal of Sociology* 94:S94–S120.

DaVanzo, J. 1977. *Why Families Move: A Model of the Geographic Mobility of Married Couples.* Washington, DC: U.S. Government Printing Office.

Duncan, R.P. and C.C. Perrucci. 1976. "Dual Occupation Families and Migration." *American Sociological Review* 41:252–61.

Epstein, C.F. 1974. "Reconciliation of Women's Roles." Pp. 473–89 in *The Family: Its Structures and Functions*, edited by R.L. Coser. New York: St. Martin's.

Etzkowitz, H., C. Kemelgor, M. Neuschatz, and B. Uzzi. 1994. "Barriers to Women's Participation in Academic Science and Engineering." Pp. 43–67 in *Who Will Do Science? Educating the Next Generation*, edited by W. Pearson Jr. and A. Fechter. Baltimore: Johns Hopkins University Press.

Fox, M.F. 1995. "Women and Scientific Careers." Pp. 205–23 in *Handbook of Science and Technology Studies*, edited by S. Jasanoff, G.E. Markle, J.C. Peterson, and T. Pinch. Thousand Oaks, CA: Sage.

Frank, R.H. 1978. "Family Location Constraints and the Geographic Distribution of Female Professionals." *Journal of Political Economy* 86:117–30.

Hargens, L.L., J.C. McCann, and B.F. Reskin. 1978. "Productivity and Reproductivity: Fertility and Professional Achievement among Research Scientists." *Social Forces* 57:154–63.

Haveman, R., B. Wolfe, and J. Spaulding. 1991. "Childhood Events and Circumstances Influencing High School Completion." *Demography* 28:133–57.

Hertz, R. 1986. *More Equal Than Others: Women and Men in Dual-Career Marriages.* Berkeley: University of California Press.

Ladinsky, J. 1967. "Occupational Determinants of Geographic Mobility among Professional Workers." *American Sociological Review* 32:253–64.

Lichter, D.T. 1980. "Household Migration and the Labor Market Position of Married Women." *Social Science Research* 9:83–97.

———.1982. "The Migration of Dual-Worker Families: Does the Wife's Job Matter?" *Social Science Quarterly* 63:48–57.

Long, J.S., P.D. Allison, and R. McGinnis. 1993. "Rank Advancement in Academic Careers: Sex Differences and the Effects of Productivity." *American Sociological Review* 58:703–22.

Long, J.S. and M.F. Fox. 1995. "Scientific Careers: Universalism and Particularism." *Annual Review of Sociology* 21:45–71.

Long, L.H. 1972. "The Influence of Number and Ages of Children on Residential Mobility." *Demography* 9:371–82.

———. 1974. "Women's Labor Force Participation and the Residential Mobility of Families." *Social Forces* 52:343–48.

———. 1988. *Migration and Residential Mobility in the United States.* New York: Russell Sage Foundation.

Maret, E. and B. Finlay. 1984. "The Distribution of Household Labor among Women in Dual-Earner Families." *Journal of Marriage and the Family* 46:357–64.

Marini, M.M. 1989. "Sex Differences in Earnings in the United States." *Annual Review of Sociology* 15:343–80.

Markham, W.T. and J.H. Pleck. 1986. "Sex and Willingness to Move for Occupational Advancement: Some National Sample Results." *Sociological Quarterly* 27:121–43.

Marwell, G., R.A. Rosenfeld, and S. Spilerman. 1979. "Geographic Constraints on Women's Careers in Academia." *Science* 205: 1225–31.

Mincer, J. 1978. "Family Migration Decisions." *Journal of Political Economy* 86:749–73.

Peek, C.W., IV. 1995. "Sources of Gender and Race/Ethnic Stratification in Non-Academic Science and Engineering." Doctoral dissertation, University of Michigan.

Polachek, S.W. 1981. "Occupational Self-Selection: A Human Capital Approach to Sex Differences in Occupational Structure." *Review of Economics and Statistics* 63:60–69.

Reskin, B.F., ed. 1984. *Sex Segregation in the Workplace.* Wash-

ington, DC: National Academy Press.
Rosenfeld, R.A. 1991. "Outcomes Analysis of Academic Careers." Review prepared for the Office of Scientific and Engineering Personnel, National Research Council.
Rosenfeld, R.A. and J.A. Jones. 1987. "Patterns and Effects of Geographic Mobility for Academic Women and Men." *Journal of Higher Education* 58:493–515.
Sandefur, G.D. 1985. "Variations in Interstate Migration of Men across the Early Stages of the Life Cycle." *Demography* 22:353–66.
Shihadeh, E.S. 1991. "The Prevalence of Husband-Centered Migration: Employment Consequences for Married Mothers." *Journal of Marriage and the Family* 53:432–44.
Sonnert, G. and G. Holton. 1996. "Career Patterns of Women and Men in the Sciences." *American Scientist* 84:63–71.
Sorensen, A. 1983. "Children and their Mother's Career." *Social Science Research* 12:26–43.
Speare, A., Jr. 1970. "Home Ownership, Life Cycle Stage, and Residential Mobility." *Demography* 7:449–58.
Speare, A., Jr. and F.K. Goldscheider. 1987. "Effects of Marital Status Change on Residential Mobility." *Journal of Marriage and the Family* 49:455–64.
Speare, A., Jr., S. Goldstein, and W.H. Frey. 1975. *Residential Mobility, Migration, and Metropolitan Change*. Cambridge, MA: Ballinger.
Spenner, K.I. and R.A. Rosenfeld. 1990. "Women, Work, and Identities." *Social Science Research* 19:266–99.
Stockard, J. and M.M. Johnson. 1980. *Sex Roles: Sex Inequality and Sex Role Development*. Englewood Cliffs: Prentice-Hall.
Turner, R.H. 1964. "Some Aspects of Women's Ambition." *American Journal of Sociology* 70:271–85.
Xie, Y. 1989. "The Process of Becoming a Scientist." Doctoral dissertation, University of Wisconsin.
Xie, Y. and K. Akin. 1994. "Sex Differences in Research Productivity." Research Report 94–322, Population Studies Center, University of Michigan.
Zuckerman, H. 1991. "The Careers of Men and Women Scientists: A Review of Current Research." Pp. 27–56 in *The Outer Circle: Women in the Scientific Community*, edited by H. Zuckerman, J.R. Cole, and J.T. Bruer. New York: W.W. Norton.