FAMILY LABOR SUPPLY, MIGRATION, AND MARRIAGE: THEORY AND ECONOMETRIC ANALYSIS

BY ELENA STOLPOVSKY

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ABSTRACT OF THE DISSERTATION

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by Elena Stolpovsky

Dissertation Director: Mark Killingsworth

In this dissertation I examine family decision using theoretical and empirical analysis. I am interested in the different roles that the main decision makers in the family play in the common decision. The first chapter focuses on the family decision about the labor supply of the wife, the second, on family residential mobility and migration, and the second, on the determinants of marriage.

The first chapter analyzes the labor supply of married and cohabiting women using the traditional (unitary) and the more recent collective models of household decision making. The unitary model assumes household-level utility function and budget constraint, while the collective model makes a less restrictive assumption that the household decisions are Pareto-optimal.

I describe the structural model of collective household labor supply and consumption, based on the paper by Donni and Moreau (The Journal of Human Resources, 2007). This model assumes complete rigidity of the labor supply of married and cohabiting men: men's hours of work are fixed, and depend not on their individual choices but on the presence of exogenous constraints in the labor market.

The collective labor supply model incorporates the household consumption of a selected good, called the conditioning good, which is a measure of the distribution of the decision-making power

within the household. I estimate the model using, in turn, three conditioning goods: food at home, clothing, and food at restaurants. The unitary labor supply model omits the conditioning good, because under the unitary model, the distribution of the decision-making power within the household does not affect labor supply.

I test the unitary and the collective models of household decision making, and estimate the labor supply elasticities of married and cohabiting women.

The estimation results, based on the data from the 2005, 2007, and 2009 Panel Study of Income Dynamics, are consistent with the collective model, but not with the unitary model. However, the labor supply elasticities of married and cohabiting women are not significantly affected by the choice of the model.

The estimated hours wage elasticity of married and cohabiting women is between 0.08 and 0.14 in 2005, and falling over time, although this decline is not precisely estimated. The women's hours income elasticity is between -0.12 and -0.07, and also declining in absolute value over 2004–2008. My results support the trend noticed in recent studies of a decline in labor supply responsiveness of married and cohabiting women to changes in their wage and family income. I conclude that women in U.S. couples are becoming similar to men in their labor supply behavior.

The second chapter of the dissertation describes a collective model of family residential mobility that incorporate the distance of moving. I specify the model parametrically and develop predictions about the dependence of the probability of moving and the distance of moving on the characteristics of the couple and the distribution of bargaining power in the family.

The empirical analysis is based on the restricted-use data on the census tract of residence of couples from the PSID for 1985–1991. The level of precision in the geographic location data allows me to differentiate between relocation and migration, and to determine the distance of moving. I define the distance of moving as the distance between the census tracts in which the family resides in two consecutive interview years. Relocation involves all moves between census tracts and migration involves moves over 10 miles that cross into a different political unit, such as a county, a metropolitan statistical area, and a core-based statistical area.

The estimation of the model includes the proportion of asset income contributed by the wife as the distribution factor that reflects the wife's bargaining power in the couple. I find that the wife's proportion of asset income affects family residential mobility, controlling for the total asset income of the couple and the indicator of whether the family receives asset income. My results are inconsistent with the income pooling hypothesis of the unitary model.

The wife's proportion of asset income interacted with the education of the husband affects the distance of moving for relocating and migrating families, and the probability of relocation for working-age couples. Greater bargaining power of the wife reduces the positive effect that the husband's education has on the probability of moving and the distance of moving.

The third chapter of the dissertation is a time-series analysis of marriage rates during 1960–2011. The marriage rate in the United States decreased over the last fifty years. This decrease was accompanied by a rapid growth in female earnings, compared to those of men, a growth in the female labor force participation, and a stagnation in the labor force participation of men. I use time-series analysis to determine whether economic factors contributed to the decline in marriages. I examine the outcomes of the model in light of the economic theory of marriage described by Becker, and more recent theories of the determinants and outcomes of marriage.

The data include yearly marriage, divorce and birth rates, and labor force participation rates and median earnings for men and women for 1960–2011. I find that the series are nonstationary and exhibit a single cointegrating relation. The cointegrating relation can be interpreted as the long-run equilibrium relationship in the series. In the long-run the marriage rate is positively related to the labor force participation rates of men and women. I build a vector error correction model and estimate structural impulse responses. Impulse response analysis shows that a positive shock to female earnings decreases the marriage rate and increases the divorce rate. According to the 1960–2011 data, an independent increase in female earning decreases the likelihood of couples to marry and stay married.

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Chapter 1

Collective and Unitary Models of Labor Supply of Married and Cohabiting Women

1.1 Introduction

Until the 1990s most empirical studies of labor supply of married men and women assumed that the husband's earnings and hours of work are exogenous to the labor supply choices of wive (Lundberg, 1988). Most theoretical studies of household labor supply were based on the assumption that the household acts as a single utility-maximizing agent with a household-level utility function and budget constraint. This approach, referred to as the unitary model, has theoretical and empirical limitations. From the theoretical standpoint, the assumption that two or more people act as a single decision-making entity is unrealistic (Arrow, 1950). Most empirical studies of household consumption that test the implications of the unitary model display results inconsistent with it (Vermeulen, 2002).

For example, Lundberg (1988) in her study of household labor supply, obtains results that do not fit into the unitary model framework. She studies labor supply of married men and women using data on U.S. husband-wife pairs interviewed in 1972. She finds that both husbands and wives in families without small children choose their employment status and hours of work independently of the labor supply choices of their spouses. In families with young children, the labor supplies of husbands and wives exhibit strong interactions and are not independently determined. Lundberg's findings suggest that the presence of important family public goods, such as children, determines whether the members of the family act as a utility maximizing unit, or make independent choices.

In the end of the 1980s and in the 1990s, collective models of household labor supply were introduced (Chiappori, 1988; Kooreman and Kapteyn, 1986; Apps and Rees, 1997; Fortin and

Lacroix, 1997). The collective approach allows for interdependence between the choices of household members, but does not rely on a household-level utility function. Its sole assumption is that the decisions made within the household are Pareto-optimal.

Chiappori et al. (2002) estimate a collective model of household labor supply using U.S. data from the 1988 Panel Study of Income Dynamics (PSID). They use the sex ratio by age, race and state of residence of couples, and divorce laws by state of residence as measures of the decision-making power of men and women in couples. In contrast withe the unitary model, they post that the individual bargaining powers of spouses affect household labor supply decisions.

Donni and Moreau (2007) develop a collective model of household labor supply based on the assumption of complete rigidity of husbands' labor supply. They analyze household choices using a single equation for the wife's hours of work. Donni and Moreau apply their single-equation labor supply model to data for 2000 on French households. Contrary to the assumptions of the unitary model, they find that changes in the distribution of the decision-making power between the spouses affect the wife's labor supply.

In this paper I estimate the single-equation collective model of household labor supply using U.S. data from the PSID for 2005, 2007, and 2009. I test the restrictions imposed by the Pareto-optimality assumption of the model. The restrictions imposed by the collective model are not rejected. I find that the distribution of exogenous income between husband and wife affects the wife's labor supply, which is inconsistent with the traditional unitary model of decision-making.

I estimate elasticities of labor supply of women in couples. I find that the wage elasticity of women's hours of work is 0.14 or lower, and, with most modeling specifications, not significantly different from zero. My estimates of exogenous-income elasticity of women's hours of work are between -0.05 and -0.12. In the following section, I review the studies of labor supply elasticities of married and cohabiting women. My estimates of wage elasticity are lower in absolute value than most of the studies based on the data before the 2000, but are consistent with the trend found by Heim (2007), based on the CPS data for 1978–2002. Similarly, my estimates of the hours income elasticity are lower in absolute value than the median estimates based on the data before the 2000. Heim's estimate of the hours income elasticity in 2002 is -0.01—lower than my estimates in absolute value.

1.1.1 Estimated Elasticities of Labor Supply of Married Women

Estimation of labor supply elasticities for married and cohabiting women has a long history, and provides a benchmark for the new research presented here. In their survey of female labor supply, Killingsworth and Heckman (1987) provide estimates of elasticities of married women's hours of work with respect to their own wage, total household income, and exogenous income, such as dividends. In studies based on U.S. data, married women's own-wage elasticities range from -0.89 to 15.2, with a median of 0.76. Married women's total-income elasticities, or the elasticities of women's labor supply with respect to the total family income, range from -0.48 to 0.48, with a median of -0.08. Exogenous-income elasticities, or the elasticities of married women's labor supply with respect to nonwork income received by the family, ranged from -0.89 to 0, with a median of -0.23.

Blundell and Macurdy (1999) summarize empirical work on family labor supply based on data from European countries and the U.S. They report estimates of married women's uncompensated wage elasticities ranging from -0.01 to 2.03, with a median of 0.77, and exogenous-income elasticities ranging from -0.40 to 0.52, with a median of -0.175.

Blau and Kahn (2005) investigate labor supply behavior of married women in the U.S. during 1980–2000 using the Current Population Survey data. They find that labor supply of married women became substantially less elastic during 1980–2000. According to their estimates, in 2000 the married women's own-wage labor supply elasticity was 0.4 and their cross-wage elasticity, or elasticity with respect to their husband's wage, was -0.2. Blau and Kahn's estimates imply a husband's own-wage elasticity of labor supply at or below 0.14 during 1980–2000, with little responsiveness of the husband's labor supply to changes in the wife's wage rates. [1]

Similarly to Blau and Kahn (2005), Heim (2007) finds a downward trend in the absolute values of labor supply elasticities of married women with respect to their own wage and exogenous income in the U.S. during 1978–2002. Heim's estimates of the married women's hours wage elasticity are not significantly different from 0 after 1992. His estimates of the married women's hours income

[1] Blau and Kahn (2005) report the magnitude of the labor supply elasticities of men and women, and not the standard errors or the significance tests. In contrast, this study includes the estimates of the elasticities as well as the standard errors.

elasticity are significantly below 0 during most of 1978–2002. If the trend recorded by Heim is extrapolated past 2002, in 2004 hours wage elasticity of married women would be 0.12, and hours income elasticity -0.01.

Evers et al. (2008) study labor supply of men and women in both Europe and the US, performing a meta analysis based on 30 empirical studies published during 1981–2007. They derive predicted wage elasticities for men and women in the Netherlands, the UK, the US and Sweden. The predicted wage elasticities of labor supply are lowest in the US, followed by the UK, and then in the Netherlands and Sweden. In the US the predicted women's wage elasticity is 0.38, and the predicted men's wage elasticity is -0.01.

1.2 Models of Household Labor Supply

Theoretical discussions of household labor supply have traditionally relied on the unitary model. The unitary model assumes that the household acts as a single utility maximizing agent. Individual preferences of household members or differences in their decision-making power are assumed not to influence household decisions. The distribution of welfare within the household is not considered in the model.

In contrast, in the collective model the household members act as individuals with separate sets of preferences. The bargaining power the individuals in the household affects their influence on the family decisions and the outcomes of the decisions for them. The collective model assumes that household decisions are Pareto-optimal. Chiappori (1988) argues that the decisions made within the household can be viewed as repeated games. If the household members have perfect information about each other's preferences, a Pareto-optimal decision-making process can be developed.

The collective model of household labor supply was first developed by Chiappori (1988, 1992). In the initial model, the household consists of two members. There is a unique consumption good, but only total household consumption is observable. Hours of work of both household members are continuous and positive. Pareto optimality is interpreted as an existence of a family welfare function equal to a weighted sum of the spouses' utility functions. The family welfare function is separable with respect to the inputs into the spouses' utility functions, their consumption and leisure, which leads to testable conditions of the collective framework. The conditions take form of partial differential equations and inequalities similar to the Slutsky conditions of consumer theory. For specific parametric forms of utility functions or demand functions the collective rationality conditions can be expressed as restrictions on the parameters of these functions. Chiappori (1988) derives and tests the restrictions of the collective and unitary models on Canadian data. The unitary model is rejected for couples, but the collective model is not.

The restrictions of the collective model developed by Chiappori (1988) are a function of prices, wages and nonlabor incomes of the household members. One extension of the collective model is to introduce distribution factors. Distribution factors are variables that affect household decisions but not individual preferences or the household budget constraint. McElroy (1990) discusses parameters that change the opportunities of household members outside the household, i.e., the threat point in the intrahousehold bargaining process. For example, divorce laws and alimony laws affect the incomes of the spouses after divorce, and the ratio of males to females in an area may affect dating prospects. Browning et al. (1994) describe distribution factors more broadly, as factors that change the distribution of power within the household without shifting the Pareto-optimal frontier. For example, the proportion of nonlabor income received by the wife may affect her ability to influence decisions without affecting preferences or the household budget constraint.

Chiappori, Fortin and Lacroix (2002) develop and estimate a collective model of household choice with distribution factors. They derive new restrictions of the collective model on the labor supply functions of the husband and the wife. Chiappori et al. estimate the model using PSID data for 1988. In their study the restrictions of the collective model are not rejected. Chiappori et al. identify the sharing rule, or the rule according to which the exogenous income of the household is divided between the household members. Their results show that a higher sex ratio and divorce laws more favorable to women increase the share of family nonlabor income distributed to the wife.

The models of Chiappori (1988) and Chiappori, Fortin and Lacroix (2002) require the labor supply of each member of the household to be positive and continuous. If one member's labor supply is not continuous, these models do not apply. Blundell et al. (2007) study couples in the UK and observe that the husbands' hours of work are concentrated in a very narrow positive region, while the wives' hours of work are more flexible. They assume that the husband's labor supply decision is discrete: the husband either does not work or works full-time. The wife's labor supply is continuous in the authors' model. Blundell et al. have two equations for the wife's hours of work depending on whether her husband works or not, and one equation describing the husband's labor force participation. They derive testable restrictions of the collective model, and show that individual preferences and the sharing rule can be recovered. Blundell et al. estimate their model with the U.K. data, and do not reject the restrictions of the collective model.

Donni and Moreau (2007) study the case when the husband's labor supply is completely fixed, while the wife's labor supply is flexible. This setup allows the authors to analyze the wife's labor supply and treat the husband's labor supply as exogenous. Donni and Moreau use household consumption of a single good, called the conditioning good, to derive information about the decision-making process within the household. Consumption is a choice, determined together with the household's labor supply choices. The endogeneity of the consumption of the conditioning good in the hours of work equation is corrected with instrumental variable estimation. Donni and Moreau specify the single-equation model parametrically and generate testable restrictions of the collective model. They estimate the model using French data and do not reject the restrictions of the collective model.

In this paper I follow Donni and Moreau (2007) in assuming complete rigidity of the labor supply of married and cohabiting men, and estimate a collective model of labor supply of married and cohabiting women with a conditioning good.

The assumption about the rigidity of married men's labor supply of married men and the relative flexibility of married women's labor supply is consistent with empirical studies based on U.S. data. Killingsworth (1983) and Heckman (1993) agree that women's labor supply is considerably more responsive to changes in wage and income than that of men. Most studies based on U.S. data find that elasticities of labor supply of married women with respect to their own wage and nonwork income are much greater in absolute value than those of married men (Killingsworth and Heckman, 1987; Blundell and Macurdy, 1999; Blau and Kahn, 2005; Evers et al., 2008).

In their application of a collective labor supply model, Chiappori et al. (2002) find that labor supply of married men is rigid, while labor supply of married women is more elastic. These researchers find that the husband's wage and income elasticities of labor supply are not statistically significant, while those of the wife are significant and equal to 0.23 for own-wage elasticity and −0.04 for nonlabor income elasticity.

My study is based on the data from the PSID for 2005–2009. I use the data on nonlabor income assignable to husbands and wives to construct a distribution factor, i.e., a variable that reflects the bargaining power of the spouses, but does not affect the utility functions or the budget constraints. My distribution factor is the proportion of income exogenous of the family labor supply decisions received by the wife. [2]I use this distribution factor to test the unitary model, test the specifications of the collective model, and look at the effect of a change in the distribution of bargaining power between the spouses on the wife's labor supply in different couples. [3]

My results are inconsistent with the unitary model, but are consistent with the restrictions imposed by the collective rationality. I choose three conditioning goods: food at home, clothing, and food at restaurants, and find that my choices of the conditioning goods satisfy the model requirement that the household expenditure on these goods varies with the change in the distribution of bargaining power in the family. Donni and Moreau use the same set of variables as conditioning goods, but do not test whether these variables contain sufficient information about the intrahousehold distribution of bargaining power.

I further extend Donni and Moreau's analysis by looking directly at the effect of the change of the relative bargaining power of the wife on her labor supply for married and cohabiting couples. I am able to do this because I have an empirical measure of the distribution factor, the wife's share of exogenous income, which is a proxy for her bargaining power. I find that an increase in the relative bargaining power of the wife decreases her hours of work in married couples and increases her hours of work in cohabiting couples. I estimate the wife's hours of work elasticity with respect to her wage at or below 0.14, compared to the Donni and Moreau's estimate of 0.40. The elasticity of the wife's hours of work with respect to exogenous income is between −0.06 and −0.12, compared to the Donni and Moreau's estimate of −0.21.

[2]In this study, the husband's hours of work are constrained to be within the full-time range, and the husband's income is assumed to be exogenous. I define the distribution factor as the ratio of the wife's nonlabor income to the family nonlabor income and the labor income of the husband. The distribution factor is formally discussed in section 3.2.

[3]Donni and Moreau discuss the role of distribution factors in their theoretical model, but do not incorporate them in empirical analysis.

My lower elasticities estimates are consistent with a recent study by Heim (2007) of labor supply of married women in the U.S., based on the CPS data. The low estimates of the elasticities of labor supply of married and cohabiting women are robust to different sample choices, such as choosing a sample of married couples only, using yearly versus weekly hours of work as the dependent variable, different functional forms in the hours of work equation, and different independent variable choices.

In section 3, I describe the labor supply model of Donni and Moreau in the context of the collective labor supply models. Sections 4 and 5 contain the description of the data and the estimation strategy. In section 6, I provide the results of the estimation of the single-equation model, focusing on the sample from 2005. Section 7 contains a discussion of the results from the 2005, 2007, and 2009 samples and concluding remarks.

1.3 Single-Equation Family Labor Supply

1.3.1 General Collective Model

In the collective approach to household decision making, each household member has an individual utility function, specifically, the household consists of two individuals i $(i = m, f)$ with utility functions that depend on their own consumption and leisure, [4] while household decisions are always efficient, or Pareto-optimal.

1.3.2 Single-Equation Labor Supply

In the collective model of Donni and Moreau the consumption goods are divided into two aggregate groups, a conditioning good x and the remaining aggregate consumption good c. The conditioning good is private, unlike household public goods such as children's welfare or housing services, and nondurable. The family consumption of the conditioning good should reflect the distribution of the bargaining power between the couples. This requirement is discussed in section 3.4 and described formally in inequality (1.14). I use food at home, clothing, and food at restaurants as conditioning goods. All of these goods are consumed privately and are nondurable. The studies of household

[4] The model can be extended to account for "altruistic" preferences, as defined by Becker (1991) (Chiappori, 1992; Donni and Moreau, 2007).

food consumption find that family expenditure on food is affected by intrahousehold bargaining (Hoddinott et al., 1997). In this paper I test the requirement formally and find that expenditure on all three conditioning goods is different for families with different distributions of bargaining power. Then, the family expenditure these conditioning goods contains information about the decision-making process in the family.

The husband's labor supply is assumed to be fixed, with the husband's hours of work, h_m, set to full time, $\bar{h}$. According to the model, all husbands prefer to be employed and work full-time, although some are unable to work full-time due to exogenous labor market constraints.

Donni and Moreau introduce the variable "nonwife income", which represents the portion of income that does not depend on the choices of the couple. It is defined as

$$\psi = y + \bar{h} w_m, \tag{1.1}$$

where y is nonlabor income of the couple, and w_m is the husband's wage rate.

Pareto efficiency means that the household solves

$$\max_{h_f, c_f, x_f} u_f(T - h_f, c_f, x_f) \tag{1.2}$$

subject to the budget constraint

$$\psi + h_f w_f \geq x_m + x_f + c_m + c_f \tag{1.3}$$

and subject to

$$u_m \geq \overline{u}_m,$$

where $\overline{u}_m$ is some required level of utility for m. T is the total time available to each person.

According to Mas-Colell et al. (1995), the household problem characterized by Pareto efficiency can be rewritten as a maximization of the social welfare function:

$$\max_{c_m, x_m, h_f, c_f, x_f} (1-\mu) \cdot u_m(T-\bar{h}, c_m, x_m) + \mu \cdot u_f(T-h_f, c_f, x_f) \tag{1.4}$$

subject to the budget constraint (equation 1.3).

The parameter μ can be interpreted as the relative bargaining power of the wife. It is a function of all of the variables in the household problem:

$$\mu = \mu(c_m, x_m, h_f, c_f, x_f, \psi, w_f, \mathbf{d}),$$

where $\mathbf{d}$ is the vector of distribution factors, i.e., variables that affect μ but do not affect individual preferences or the household budget constraint.

In this paper I choose a single distribution factor s equal to the proportion of income exogenous of the couple's labor supply choices received by the wife: [5]

$$s = y_f/\psi$$

I interpret s as the factor that increases the bargaining power of the wife relative to that of the husband. The wife's bargaining power μ becomes

$$\mu = \mu(c_m, x_m, h_f, c_f, x_f, \psi, w_f, s).$$

The distribution factor s does not enter the wife's labor supply equation directly. The distribution of bargaining power between the spouses is reflected by the the household expenditure on the conditioning good. However, for the single-equation representation to exist, the household expenditure on the conditioning good should contain information about s. I discuss this requirement in section 3.4.

[5] Donni and Moreau propose a distribution factor equal to the proportion of exogenous income coming from the nonlabor income of the family, i.e. $s = y/\psi$. The disadvantage of this choice of the distribution factor is that it does not directly correspond the bargaining power of one of the spouses.

1.3.3 Decentralization

The collective household problem can be represented in two stages. In the first stage, the spouses divide nonwife income ψ. In the second stage, each spouse maximizes his or her own utility subject to the budget constraints determined in stage 1. The possibility of this decentralization is demonstrated by Apps and Rees (1997).

The husband solves:

$$\max_{c_m, x_m} u_m(T - \bar{h}, c_m, x_m) \tag{1.5}$$

subject to the budget constraint

$$x_m + c_m \leq \rho, \tag{1.6}$$

where ρ is the share of the family nonwife income ψ that the husband receives. ρ is called the sharing rule. It is chosen in the first stage, and is a function of the given (exogenous) variables in the problem.

$$\rho = \rho(\psi, w_f, \mathbf{d}, \mathbf{z}), \tag{1.7}$$

where $\mathbf{d}$ is the vector of distribution factors, and $\mathbf{z}$ is a vector of household sociodemographic characteristics.

I define $s = y_f/\psi$ as the only distribution factor. Then,

$$\rho = \rho(\psi, w_f, s, \mathbf{z}). \tag{1.8}$$

The wife solves:

$$\max_{h_f, c_f, x_f} u_f(T - h_f, c_f, x_f) \tag{1.9}$$

subject to

$$x_f + c_f \leq (\psi - \rho) + h_f w_f. \tag{1.10}$$

The restrictions that consumption is nonnegative and that hours of work are between 0 and T are also imposed.

The solution to the wife's maximization problem is her choice of hours of work

$$h_f^*(w_f, \psi, s, \mathbf{z}) = \eta_f(w_f, \psi - \rho(\psi, w_f, s, \mathbf{z})), \tag{1.11}$$

where η_f is the wife's Marshallian labor supply.

For an interior solution, in other words, when the wife works a positive number of hours, Slutsky positivity should hold:

$$\frac{\partial \eta_f}{\partial w_f} - \frac{\partial \eta_f}{\partial(\psi - \rho)} \cdot h_f > 0. \tag{1.12}$$

Each spouse chooses the level of the conditioning good that solves his or her respective maximization problem. The optimal level of the conditioning good for the household is given by

$$x^*(w_f, \psi, s, \mathbf{z}) = x_m^*(\rho(w_f, \psi, s, \mathbf{z})) + x_f^*(w_f, \psi - \rho(w_f, \psi, s, \mathbf{z})), \tag{1.13}$$

where x_i^* is the optimal choice of x for spouse i.

1.3.4 Wife's Labor Supply Equation With the Conditioning Good

The conditional wife's labor supply model is an empirical representation of the collective household labor supply model that incorporates the information from the household's optimal choice of the conditioning good, x^*.

A conditional labor supply representation exists only if

$$\frac{\partial x^*}{\partial s} \neq 0. \tag{1.14}$$

A change in the proportion of exogenous household income coming from the wife affects household consumption of the conditioning good. If the wife's input into the household exogenous income reflects her bargaining power, condition (1.14) means that the household consumption of the conditioning good is affected by the changes in the distribution of the bargaining power within the couple.

If condition (1.14) is satisfied, we can invert equation (1.13) to get

$$s = s^*(w_f, \psi, x^*, \mathbf{z}). \tag{1.15}$$

The optimal choice of the conditioning good x provides information about the value of the distribution factor s.

Putting s into equation (1.8), we get the s-conditional sharing rule κ, or the dependence of the husband's share of exogenous income on s.

$$\kappa(w_f, \phi, x, \mathbf{z}) = \rho(w_f, \psi, s^*(w_f, \psi, x^*, \mathbf{z}), \mathbf{z}). \tag{1.16}$$

Introducing the s-conditional sharing rule κ instead of ρ into the wife's choice of hours of work in equation (1.11), we have the following optimal choice of the wife's hours of work, for positive hours of work: [6]

$$h_f(w_f, \psi, x, z) = \eta_f(w_f, \psi - \kappa(\psi, w_f, x, \mathbf{z})). \tag{1.17}$$

Note that the s-conditional sharing rule κ is a solution to

$$x(w_f, \psi, s, \mathbf{z}) = x_m^*(\kappa(w_f, \psi, s, \mathbf{z})) + x_f^*(w_f, \psi - \kappa(w_f, \psi, s, \mathbf{z})). \tag{1.18}$$

[6] Equation (1.17) describes the interior solution to the wife's utility maximization problem with respect to her hours of work. Donni and Moreau (2007) and this work do not consider intrahousehold bargaining in the wife's labor force participation decision. In the collective model, labor force participation of the wife may be affected by the distribution of the bargaining power within the family. Empirically, the household expenditure on the conditioning good could be used to reflect the distribution of the bargaining power between the spouses in the labor force participation decision. Future research is needed to describe and estimate such an extension of the collective labor supply model with a conditioning good.

This result follows from the definition of s^* and κ in equations 1.15 and 1.16.

1.3.5 Properties of Collective Labor Supply Model with the Conditioning Good

Define

$$\alpha(w_f, \psi, x, \mathbf{z}) = -\frac{\partial h_f}{\partial \psi}\left(\frac{\partial h_f}{\partial x}\right)^{-1} \text{and } \beta(w_f, \psi, x, \mathbf{z}) = \frac{\partial h_f}{\partial x}\left(\frac{\partial \alpha}{\partial \psi}\frac{\partial h_f}{\partial x} - \frac{\partial \alpha}{\partial x}\frac{\partial h_f}{\partial \psi}\right)^{-1}, \tag{1.19}$$

where α can be interpreted as the slope of the husband's Marshallian demand for the conditioning good x. [7] The slope of the husband's Marshallian demand for x is the change in the husband's chosen level of x, x_m^*, in response to the change in the exogenous income received by the husband, κ:

$$\frac{x_m^*}{\kappa} = -\frac{\partial h_f/\partial \psi}{\partial h_f/\partial x} = \alpha. \tag{1.20}$$

β is the inverse of the derivative of the slope of the husband's demand for x.

Assume that the wife's hours of work are positive and satisfy the following regularity conditions:

$$\frac{\partial h_f}{\partial x} \neq 0, \tag{21.1}$$

$$\frac{\partial \alpha}{\partial x} \neq 0, \text{ and} \tag{21.2}$$

$$\frac{\partial \alpha}{\partial \psi}\frac{\partial h_f}{\partial x} \neq \frac{\partial \alpha}{\partial x}\frac{\partial h_f}{\partial \psi}. \tag{21.3}$$

(21.1) means that the slope of the wife's labor supply Engel curve, or her labor supply as a function of household income, is not equal to 0. (21.2) and (21.3) mean that the slope of the

[7] The Marshallian demand function specifies the demand for a good in each price and wealth situation, assuming that it solves the utility maximization problem.

husband's Engel curve for the demand for the conditioning good is different from zero.

Given equations (21), the following propositions hold:

(a) The conditional sharing rule $\kappa(w_f, \psi, x, \mathbf{z})$ can be retrieved up to a function k of the household's characteristics $\mathbf{z}$. Given the sociodemographic characteristics of the household that affect preferences and the sharing of income, the conditional sharing rule can be retrieved. [8]

The function of the sociodemographic factors $k(\mathbf{z})$ has the following derivatives

$$\frac{\partial k}{\partial w_f} = \frac{\partial \alpha}{\partial w_f}\beta, \; \frac{\partial k}{\partial x} = \frac{\partial \alpha}{\partial x}\beta, \; \frac{\partial k}{\partial \psi} = \frac{\partial \alpha}{\partial \psi}\beta. \tag{1.22}$$

The results above are derived by differentiating the wife's conditional labor supply $h_f(w_f, \psi, s, \mathbf{z})$ with respect to ψ and x.

(b) Given $k(\mathbf{z})$, the wife's marginal rate of substitution between total consumption $(c_f + x_f)$ and leisure is uniquely defined.

(c) The wife's Marshallian labor supply and the spouses' individual Marshallian demands can be retrieved up to a function of $\mathbf{z}$.

1.3.6 Restrictions of the Collective Model

If the regularity conditions (21) of the wife's labor supply hold, then

$$\frac{\partial \alpha}{\partial w_f}\frac{\partial \beta}{\partial x} - \frac{\partial \alpha}{\partial x}\frac{\partial \beta}{\partial w_f} = \frac{\partial \alpha}{\partial \psi}\frac{\partial \beta}{\partial x} - \frac{\partial \alpha}{\partial x}\frac{\partial \beta}{\partial \psi} = 0. \tag{1.23}$$

Condition (1.23) follows from application of the Young's Theorem (symmetry of partial derivatives) to the sharing rule (1.16). The system of differential equations appears due to the separability property of the optimal choices of the wife's labor supply (1.11) and household consumption of the conditioning good (1.13).

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[8]The proof of this can be found in Donni and Moreau (2007).

The regularity conditions (21) also imply that

$$\frac{\partial h_f}{\partial w_f} - \frac{\partial \alpha}{\partial w_f}\frac{\partial h_f/\partial x}{\partial \alpha/\partial x} + \frac{\partial h_f/\partial x}{\beta(\partial \alpha/\partial x)} > 0. \tag{1.24}$$

The inequality (1.24) follows from applying the Slutsky positivity condition (1.12) to the wife's conditional labor supply (equation 1.17). [9] Conditions (1.23) and (1.24) provide tests of the Pareto optimality of household decisions.

1.3.7 Parametric Specification

Following Donni and Moreau, I use a quadratic form of the wife's conditional labor supply equation. This functional form has a tractable but flexible parametric representation of the restrictions of the collective model. The parametric model of the wife's labor supply is

$$h_f = \alpha'\mathbf{z} + a_{01}w_f + a_{02}\psi + a_{03}x + a_{11}w_f^2 + a_{22}\psi^2 + a_{33}x^2 + a_{12}w_f\psi + a_{13}w_f x + a_{23}\psi x, \tag{1.25}$$

where h_f is the wife's weekly hours of work, $\mathbf{z}$ is the vector of sociodemographic factors such as the wife's age and number of children, ψ is nonwife income, x is the conditioning good, and w_f is the wife's hourly earnings.

Given the quadratic labor supply form, restrictions (1.23) and (1.24) become

$$2a_{33}a_{12} - a_{13}a_{23} = a_{23}a_{23} - 4a_{22}a_{33} = 0 \text{and} \tag{1.26}$$

$$\left(a_{01} - \frac{a_{03}a_{02}}{2a_{33}}\right) + 2\left(a_{11} - \frac{a_{13}^2}{4a_{33}}\right)w_f - \left(a_{02} - \frac{a_{03}a_{23}}{2a_{33}}\right)h_f > 0. \tag{1.27}$$

Restriction (1.26) is a function of the coefficients of the wife's labor supply regression, and not the data. Therefore, it can be statistically tested, and confidence intervals can be constructed. Note that with a more general functional form of the wife's labor supply, restriction (1.26) may not be

[9]The complete derivations of restrictions (1.23) and (1.24) are in Donni and Moreau (2007).

independent of the individual data, and may not be testable.

Restriction (1.27) depends on the the wife's wage w_f and the wife's hours of work h_f, which are different for each couple. Therefore, it cannot be tested globally. I compute the estimate of the restriction for all couples and test the restriction for the mean value of the estimate.

1.4 Data

The data come from the Panel Study of Income Dynamics (PSID)—a longitudinal survey of a representative sample of American individuals and families conducted by the University of Michigan. The data used here refer to couples interviewed in 2005, 2007, and 2009. The key variables, such as the weekly hours of work, nonlabor income and wage rates refer to the year prior to the interview.

The samples consist of men and women partners ages 19–61 who are married or had lived together for a year or more. [10] In my sample 90 percent of the couples are married. The man in the couple is referred to as the husband, and the woman, as the wife.

I exclude couples that received government aid, such as transfer income [11] and food stamps. Government aid depends on earnings and cannot be treated as exogenous nonlabor income in labor supply estimation. Two thirds of couples in the original sample do not receive government aid.

Figure 1 shows the husband's and the wife's weekly hours of work for the sample of couples interviewed in 2005. [12] Ninety six percent of couples have husbands with positive weekly hours of work, and eighty three percent of couples have wives with positive weekly hours of work. [13] The hours of work per week are clustered at 30, 35, 40, 45, 50, 55, and 60, with the greatest concentration occurring at 40 hours per week. Nearly one third of husbands and one third of wives report working exactly 40 hours per week. [14] The wives' hours of work are more dispersed than

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[10] I do not consider same-sex couples. The PSID does not provide sufficient information on same-sex couples.

[11] Transfer income consists of social security income, TANF, and child support.

[12] I present the summary statistics, and provide complete estimation results for the 2005 sample of couples. The results using the 2007 and 2009 samples are presented in a more condensed form.

[13] The spouses with positive weekly hours of work include individuals who do not work during the whole year.

[14] I do not account for clustering of reported hours of work per week in the data at the multiples of 5. I assume that this concentration of observations of weekly hours of work is not correlated with the characteristics of couples that determine the wife's labor supply, her wage, or family expenditure. Further research is needed to implement a statistical method of correcting for clustering of hours of work data in the estimation of labor supply models.

those of the husbands. The standard deviation of the hours of work in the 2005 sample is 14 for husbands and 18 for wives.

Table 1 shows the proportions of husbands and wives working year-round and full-time. Full-time work is defined as working 35 hours or more per year, and year-round work means working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. In my estimation I focus on the couples with husbands and wives working year-round. This sample choice ensures consistent measurement of variables in the estimation of the wife's hours of work equation. The wife's hours of work are reported per week for the weeks when she worked, while nonlabor income is reported per year, and household expenditure may be reported per week, month or year. The data supports the premise of the model that the husbands' hours of work are rigid. Four percent of the husbands working year-round work less than 35 hours per week. The hours of work of the wives are more flexible, with twenty percent of wives that work year-round working part-time.

Table 2 describes the variables in the model. Nonwife income, the sum of nonlabor income of the couple and the income of the husband, is defined according to equation (1.1). The husbands' fixed hours of work are set to 47—the average hours of work for husbands that work 35 hours a week or more in the 2005–2009 samples.

Table 3 contains descriptive statistics of the 2005 sample used to estimate the wife's labor supply equation. All monetary variables are normalized to values per week and measured in tens of dollars.

1.5 Empirical Strategy

1.5.1 Choice of the Sample

I fit the wife's conditional labor supply equation (1.25) for the data for 2005, 2007, and 2009 separately. [15] I discuss detailed results from the estimation for the 2005 sample. I examine how

[15] I also fit the labor supply model using the data from 2005, 2007, 2009 combined. I do not report the results due to econometric limitations of the analysis. In the2005–2009 sample combined, some couples appear multiple times. Removing couples that appear multiple times may induce a selection bias, while keeping them makes some observations non-independent. A correction for non-independence of observations, such as, for example, the clustering of standard errors, makes the instrumental variable estimation in my case unstable.

the results for the other two years compare with the results for 2005, and present a summary of the results for all three years.

The 2005 sample consists of 1311 couples with husbands working full-time, year-round, and wives working year-round. The single-equation model of household labor supply relies on the assumption that the husbands' labor supply is fixed. The selection of wives into year-round employment is modeled using an extended sample of 1782 couples with husbands working full-time, year-round, and working and non-working wives.

1.5.2 Variables of the Model

The wife's labor supply equation with the conditioning good in parametric representation is

$$h_f = \alpha'\mathbf{z} + a_{01}w_f + a_{02}\psi + a_{03}x + a_{11}w_f^2 + a_{22}\psi^2 + a_{33}x^2 + a_{12}w_f\psi + a_{13}w_fx + a_{23}\psi x,$$

where h_f is the wife's weekly hours of work, $\mathbf{z}$ is the vector of the sociodemographic characteristics of the couple, w_f is the wife's hourly earnings, ψ is nonwife income, and x is the conditioning good.

The variables used in the estimation of the wife's labor supply are defined in Table 2. The wife's wage is calculated by dividing the wife's annual labor income by her annual hours of work. The wife's annual hours of work are the product of the wife's average weekly hours of work and her weeks worked. This definition of the wife's wage rate induces a division bias in the wife's labor supply equation: the wife's wage rate may be correlated with the error term in the expression for the wife's hours of work. I correct this possible bias by using an instrumental variable regression. The correction is discussed in section 5.5.

Nonwife income, the sum of nonlabor income of the couple and the income of the husband, is defined according to equation (1.1). The husbands' fixed hours of work are set to 47—the average hours of work for husbands working full-time in the 2005–2009 samples.

I use, in turn, each of three conditioning goods: food consumed at home, clothing, and food consumed at restaurants. As required in the model, the conditioning goods are private and non-durable. The wife's hours of work and family expenditure on the conditioning good are the choices that the couple makes during the same period. Therefore, family expenditure on the conditioning good is necessarily endogenous in the wife's hours of work equation. I use an instrumental variable regression to correct for the endogeneity of the expenditure on the conditioning good.

The couple's characteristics in the wife's hours of work equation are the wife's age, family needs in the previous year, [16] whether the wife has a college degree, and dummy variables related to the characteristics of the wife's first full-time job and the couple's state of residence. [17]

1.5.3 Tests of the Unitary and Collective Models

A simple test of the unitary model of household labor supply is whether an empirical measure of the distribution of bargaining power between the spouses affects labor supply. If the unitary model holds, the changes in the bargaining power of one of the spouses should not affect on the wife's labor supply. Under the unitary model, the wife's hours of work are not affected by the household consumption of the conditioning good, which is a measure of the bargaining power of the spouses. Similarly, in the unitary model, a distribution factor s should not affect the wife's labor supply. I define s as the proportion of exogenous income coming from the wife's nonlabor income. I do not find a significant effect of the family expenditure on the conditioning goods on the wife's labor supply. The distribution factor s has a significant effect on the wife's hours of work that differs for married and cohabiting couples. I discuss these results in Section 6.4.

While the unitary model imposes rigid restrictions on the couple's decision making, the more general collective model only requires that the couple's decisions are collectively rational, or Pareto optimal. I test conditions (1.26) and (1.27) imposed by collective rationality. The test employs the Delta method to estimate standard errors for nonlinear functions of parameter estimates (Weisberg,

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[16] The variable "family needs" is based on the Census needs standard, and depends on the number of children in the family. I do not include the variable "number of children" in the wife's labor supply estimation, because the current number of children may be codetermined with labor supply. The variable "family needs in previous year" is related to the number of children in the year prior to the interview, and is used as an exogenous measure of the number of children in the family.

[17] Table 2 contains detailed definitions of the independent variables in the labor supply equation.

2005). I test the restrictions of the collective model for each of the conditioning goods and discuss the results in sections 6.1 and 6.2. Collective rationality can never be rejected.

The conditional labor supply model is an empirical representation of the collective labor supply model that incorporates the family expenditure on a conditioning good. For this representation to exist, the conditioning good must contain information about the intrahousehold decision-making process. This property of the conditioning good is formally described in condition (1.14). A change in the distribution factor that reflects the relative bargaining power of the spouses should affect the household consumption of the conditioning good. I test condition (1.14) using the wife's contribution to exogenous income as the distribution factor. I find a significant effect of the distribution factor s on the household expenditure on food at home, clothing, and food at restaurants in the 2005 sample. These results are discussed in sections 6.1 and 6.2.

1.5.4 Sample Selection Correction

The collective labor supply model is estimated using a sample of couples in which both members work year-round and men work full time. This choice of the sample may induce a selection bias. The model is based on the assumption that couples do not make decisions related to the husband's labor supply. However, couples decide whether the wife works year-round, and, if she does, how many hours per week she works. The couple's decision about the wife's participation in year-round work is codetermined with its decision about the wife's hours of work and family expenditure. Therefore, sample selection should be considered in the estimation of the wife's hours of work and in the first stage regression of the couple's expenditure on the conditioning good. The estimation of the wife's wage is also likely to be affected by sample selection, because unobserved characteristics that determine the wife's participation can affect her wages (Heckman, 1979).

I use the Heckman (1979) correction method to correct for the selection of wives into year-round work. The Heckman correction for sample selection involves estimating a probit model of the wife's participation in year-round work and generating an inverse Mills ratio from the estimated parameters. The inverse Mills ratio is interpreted as the conditional mean of the unobservable characteristics of the couples in which the wives work. The inverse Mills ratio is then included as an additional explanatory variable in the estimation of the wife's hours of work and used as an instrument for her wage rate and for the family expenditure on the conditioning goods. The standard errors in the wife's hours of work and wife's wage regressions are corrected to account for the estimation of the inverse Mills ratio.

The selection equation includes independent variables from the wife's hours of work equation and additional instruments that affect the selection of wives into year-round work, but do not affect the wife's hours of work. Table 4 contains the results from the selection equation. The variables excluded from the wife's hours of work equation are indicators of the husband's and the wife's race and religious affiliation. The couple's preferences regarding the participation of the wife in the labor force depend on the cultural background of the spouses. Race and religious affiliation are important components of the cultural background of the spouses. I assume that race and religious affiliation of husbands and wives do not determine the wife's hours of work for couples with wives works year-round. Other variables excluded from the wife's hours of work estimation are an indicator for the presence in the household of a child age 5–18 in the household, an indicator of the marital status of the man in the couple, and variables related to the first full-time job of the wife not included in the wife's hours of work equation.

1.5.5 Instrumental Variable Estimation

The wife's wage rate and family expenditure on food at home, clothing or food at restaurants may be endogenous in the wife's labor supply decision. I estimate wife's hours of work assuming that all explanatory variables are exogenous, correct for the possible endogeneity using instrumental variable regression, and test whether the wife's wage and family expenditure on conditioning goods are endogenous. I find evidence of endogeneity of the conditioning goods, but not of the wife's wage.

I compute the standard errors for the instrumental variable estimates by bootstrapping the estimation procedure with 4000 bootstrap replications. I report the bootstrapped standard errors, because the covariance matrix for the instrumental variable estimator, described in Cameron and Trivedi (2005), does not account for sample selection and the estimation error introduced by the inverse Mills ratio (Wooldridge, 2010). For each bootstrap sample, I calculate the instrumental variable estimate by estimating the wife's labor force participation, the wife's wage and family expenditure, and the instrumental variable regressions.

Instrumenting Wage Rate

A large body of literature on family labor supply treats the wage as exogenous (Ransom, 1987). The studies that address the possibility of endogeneity of the wage in labor supply equations typically use instrumental variable estimation.

In instrumental variable estimation the possibly endogenous variables, expenditure on the conditioning good, and the wife's wage, are regressed on a set of instruments (including squares and interaction terms) to create a predicted value for the endogenous variables. The predicted values are used to construct the instrumental variable estimator (Cameron and Trivedi, 2005).

The instruments for the wage rate often include age or education (Kooreman and Kapteyn, 1986; Devereux, 2004)). Donni and Moreau (2007) follow Bourguignon and Magnac (1990) and Blundell et al. (1998) in using the wife's education as an excluded instrument for the wife's wage rate, instead of a including it as a regressor in the labor supply equation.

I allow for the wife's education to affect her preferences for work, but assume that this effect is more limited than the effect of the wife's education on her wages. [18] I include a binary measure of education, a variable indicating whether the wife graduated from college, as a regressor in the wife's hours of work estimation. The continuous variable "wife's years of schooling, " its square, indicators for whether the wife attended and graduated college, and years of schooling of the wife's mother are used as regressors in the wife's wage equation.

Other instruments for the wife's wage rate include a binary variable indicating whether the family resides in an urban area, and a variable reflecting the husband's migration history. An inverse Mills ratio is also included in the wife's wage equation to account for the sample selection bias. Table 6 displays the results of the estimation of the wife's wage equation. The inverse Mills ratio has a positive and significant coefficient in the wife's wage equation. This means that the wives that work year-round have unobservable characteristics that are also correlated with higher

[18] For a comparison with the studies listed above, I fit a labor supply model that uses the wife's education as an excluded instrument. I estimate a slightly larger (0.14) and statistically significant wife's wage hours elasticity. Section 6.6 presents the sensitivity analysis where these results are discussed.

wages.

Instrumenting Expenditure on the Conditioning Goods

The couple's choice of the expenditure on the conditioning good is endogenous in the couple's decision-making process. My identification strategy is to use the time unit for the expenditure on the conditioning good as an instrument for the conditioning good expenditure. The survey respondent chooses to report expenditure on food at home, clothing, and food away from home per week, per two weeks, per month, or per year. I assume that the reported period of expenditure is unrelated to the couple's labor supply decisions, but is related to the expenditure on the conditioning good. The couple that shops for food or clothing, or eats away from home more frequently is more likely to report expenditure on these goods per week instead of per year.

The results of the estimations of the family expenditures on the food at home, clothing and food at restaurants are presented in Tables 7, 12, and 15, respectively. Couples that report frequent periods of expenditure have higher expenditure on conditioning goods, as expected. Other instruments excluded from the wife's hours of work equation are variables related to the husband's education, race of the spouses, and urban or rural area of residence. The husband's education should not affect the wife's labor supply if her own education is included in her labor supply estimation. However, it can affect the household preferences for the conditioning good. I find that husbands with more years of schooling spend more on food at restaurants. Couples with wives that are black spend less on food at home and at restaurants. Families residing in urban areas have greater expenditure on all three conditioning goods.

The estimation of the family expenditure on clothing includes the sales tax on clothing in the couple's state of residence. The tax rates are taken from the "The Books of State" published by the Council of State Governments. The square of the clothes tax and interactions with the variable reflecting whether the couple reports expenditure on clothing per year are also included as instruments. The tax rate, its square and its interactions have a jointly significant affect on the family expenditure on clothing.

I include the average monthly temperatures in the state where the couple resides, and the month of the interview as instruments for expenditures on clothing and on food at restaurants. Families that live in the states where seasons are more extreme may spend more on clothes. Weather may affect whether people go out and eat at a restaurant. The average monthly temperatures appear jointly significant in the clothing and restaurant food estimations. If the interview occurs in a month in which families tend to spend more on clothing and eating out people may report higher expenditure on these goods. I find that families report spending more on clothing and food away from home if the interview occurs in the end of summer or in autumn than if they are interviewed in spring or in early summer. The estimation of the family expenditure on food at restaurants includes dummy variables reflecting how often the family eats the main meal of the day together, at home or at restaurants. Families that eat together more frequently spend less on food at restaurants.

The inverse Mills ratio is included in the estimation of family expenditure on all three conditioning goods to account for the possibility of selection bias. Families with wives working year-round do not appear to differ in their expenditure on the conditioning goods from families with wives that do not work.

1.6 Estimation Results

In this section I discuss the results of the estimation of the wife's labor supply, focusing on the 2005 sample of couples. In sections 6.1 and 6.2, I present the estimation of the collective wife's labor supply model using, in turn, food at home, clothing, and food at restaurants as the conditioning good. In section 6.3, I estimate the a unitary model of wife's labor supply model without the conditioning good. The magnitudes of the elasticities of the wife's hours of work in the unitary model are very close to the elasticities of the wife's hours of work when expenditure on food at home is included as the conditioning good. In section 6.4, I include the distribution factor, the wife's contribution to the exogenous income, into the wife's labor supply model, and test the unitary model. Section 6.5 summarizes the results of the estimation of the collective wife's labor supply model with a conditioning good using the 2007 and 2009 sample. The sensitivity analysis of the wife's labor supply elasticities is discussed in section 6.6.

1.6.1 Food Consumed at Home as the Conditioning Good

Studies of household food expenditure find that it is influenced by the distribution of bargaining power among the household members (Haddad and Hoddinott, 1997). In these studies the contributions of the spouses to family income are often used as proxies for the bargaining power of the spouses. The collective household labor supply model with the household expenditure on the conditioning good that reflects intrahousehold bargaining exists only if the household expenditure is affected by the distribution of bargaining power between the spouses (condition 1.14). To test whether food at home can be used as the conditioning good I regress the household food expenditure on the share of the exogenous income contributed by the wife s, its interaction with the indicator of whether the couple is married, and a set of independent variables. [19] The results of the test are reported in Table 7. I allow for the share s to affect married couples differently than cohabiting couples. In married couples a higher share of exogenous income coming from the wife leads to higher family expenditure on food, while in cohabiting couples the effect is reversed. The distribution factor s and its interaction with the indicator of being married are jointly significant at the 10-percent level.

Less than 1 percent of couples do not report their household's expenditure on food at home or report zeros. I exclude these couples from the estimation of the wife's labor supply with food at home as the conditioning good.

In Table 5 I present the results of the estimation of the wife's weekly hours of work assuming that the wife's wage and food at home are exogenous. The regression includes the inverse Mills ratio derived from the estimation of the wife's participation in year-round employment (Table 4). The covariance matrix accounts for the error introduced by the estimation of the inverse Mills ratio (Heckman, 1979). The inverse Mills ratio is negative and significant, indicating the presence of selection bias.

Tables 6 and 7 contain the first-stage regressions for the endogenous variables, the wife's wage rate and family expenditure on food. The first-stage regressions include the sample selection term, the inverse Mills ratio. As discussed in section 5.1, sample selection may affect wife's wage and

[19] The independent variables are the variables used in predicting food expenditure for the instrumental variable estimation.

family expenditure. The inverse Mills ratio is significant in the wife's wage regression but does not effect the family expenditure on food at home, or the other two conditioning goods.

I test for endogeneity of the wife's wage and expenditure on food using the Hausman test for endogeneity (Cameron and Trivedi, 2005). The residuals from the first-stage regressions instrumenting the endogenous variables (the wife's wage and food expenditure), are included in the wife's hours of work regression. If the variables are exogenous, the residuals should not significantly affect the wife's hours of work. The product of the residuals is included to test for endogeneity of the interaction of the wife's wage and food expenditure. [20] Table 9 presents the results of the test of endogeneity. The residuals from the first-stage regressions and their squares do not appear significant in the hours of work regression. The product of the residuals from the two first stage regressions affects hours of work at the 1-percent significance level. This result suggests that the wife's wage, expenditure on food, or both of these variables are endogenous in the wife's labor supply estimation.

I next simplify the wife's hours of work model and exclude the squares of the endogenous variables and their interaction term. This allows me to perform a test of endogeneity of the wife's wage and food expenditure by including the residuals from the first stages without the squares of the residuals and their interaction terms. The results of this simplified endogeneity test are presented in Table 10. The test provides evidence of endogeneity of the household expenditure on food, but not of the wife's wage. [21]

Table 8 presents the instrumental variable estimation of the wife's labor supply with food at home as the conditioning good. The elasticities of the wife's hours of work with respect to her wage, nonwife income, and food are displayed on the bottom of the table. I calculate the standard errors for mean observations using the Delta method, which enables estimation of the standard errors for nonlinear functions of parameter estimates (Weisberg, 2005).

The elasticities of the wife's hours of work with respect to wage rate and conditioning good are below 0.11 and not significantly different from zero. This is the case for all choices of the

[20] This idea was suggested to me by Professor Klein at Rutgers University.

[21] The tests of endogeneity based on the 2007 and 2009 samples suggest that the wife's wage is endogenous in the wife's hours of work regression.

conditioning goods and for all years of analysis. The elasticity of the wife's hours of work with respect to nonwife income is -0.07 and significant. Exogenous-income elasticities of the wife's labor supply are negative and significant when food at home and clothing are used as conditioning goods in the 2005 sample.

Table 11 displays the results of the test of the restrictions of the collective model of family decision making (restrictions 1.26 and 1.27). I test the restrictions using the results from the instrumental variable estimation. The first three lines in the table correspond to restriction (1.26). This restriction is tested globally. The last line of the table, the Slutsky positivity restriction, is dependent on the individual observations in the data. I present the standard errors for the mean estimate. The restrictions of the collective model are not rejected.

1.6.2 Clothing and Food Consumed at Restaurants as the Conditioning Goods

The conditional labor supply representation of the collective model exists if the household expenditure on the conditioning good is affected by intrahousehold bargaining. I test the condition for the existence of the conditional labor supply representation with clothing and food at restaurants as the conditioning goods by regressing the household expenditure on these goods on the distribution factor s and the independent variables used in the first stage of instrumental variable estimation. The results are reported in Tables 12 and 15. Greater wife's contribution to family exogenous income is correlated with greater household expenditure on clothing at the 1-percent significance level, and with greater household expenditure on food at restaurants at the 10-percent significance level. [22]

Five percent of couples report no spending on clothing and are excluded from the estimation of the model with clothing as the conditioning good. When the conditioning good is food at restaurants, four percent of couples with zero expenditure are excluded from the estimation sample. The

[22] In my test of the condition for the existence of the collective labor supply representation with clothing as the conditioning good I find that the distribution factor s, or the wife's contribution to exogenous income, has a positive and highly significant effect on clothing expenditure. s interacted with the indicator of whether the couple is married is not significant, unlike the case when food at home is the conditioning good. The women with greater bargaining power prefer to spend more on clothing regardless of whether they are married or not.

Hausman tests of endogeneity display evidence of endogeneity of clothing and food at restaurants. The results of these tests are similar to the results of testing for endogeneity of food at home.

Table 13 displays the instrumental variable estimation of the wife's labor supply using clothing as the conditioning good, and Table 16, the estimation of the wife's labor supply using food at restaurants as the conditioning good. I report bootstrap standard errors to correct for sample selection and instrumental variable estimation. Family expenditure on clothing and food at restaurants have no statistically significant effect on the wife's hours of work. [23]

The wife's hours wage elasticity is 0.07 when clothing is the conditioning good, and 0.09 when food at restaurants is the conditioning good, compared to 0.08 when food at home is the conditioning good. The hours wage elasticity is imprecisely estimated in models with all conditioning goods. The wife's hours income elasticities when clothing, and food at restaurants are used as conditioning goods are -0.11, and -0.12. These estimates are below the -0.07 estimate when food at home is the conditioning good. The hours income elasticity is significantly different from 0 when clothing is the conditioning good, but not when food at restaurants is the conditioning good.

I test the restrictions of the collective model when clothing and food at restaurants are the conditioning goods, and report the results in Tables 14 and 17. The restrictions of the collective model cannot be rejected, as in the case of food at home as the conditioning good.

1.6.3 The Wife's Labor Supply without the Conditioning Good

In this section I estimate a model of the wife's labor supply that does not include a conditioning good. The model without the conditioning good or another measure of the distribution of bargaining power between the spouses is a unitary model.

I find that sample selection affects the wife's labor supply, as in the case of the model with the conditioning good. The elasticities of the wife's hours of work with respect to wage and nonwife income are similar to the case when a conditioning good is included in the wife's hours of work regression. The hours wage elasticity is 0.07 and not statistically significant, and the hours income

[23] I also compute standard errors based on the theoretical covariance matrix for an instrumental variable estimator without sample selection. I find that the three conditioning goods, and their squares and interaction terms do not affect the wife's hours of work, with the exception of the interaction between the wife's wage and family expenditure on clothing.

elasticity is -0.08 and significant. I perform a Hausman test to test for endogeneity of the wife's wage in the wife's hours of work estimation, when no conditioning good is included. I report the results at the bottom of Table 18. I do not find evidence of endogeneity of the wife's wage.

1.6.4 Test of the Unitary Model

Under the unitary model, the distribution of bargaining power within the household does not affect household decisions. I have two measures of the distribution of bargaining power between the spouses: instrumented family expenditure on the conditioning good, and the wife's contribution to the family income exogenous of labor supply s. The distribution factor s is a natural proxy for bargaining power, because it is directly related to the bargaining power of the wife. A greater s reflects a greater share of resources controlled by the wife, and consequently, higher wife' bargaining power. The disadvantage of using s in the test of the unitary model is that s is zero for the couples, in which wives do not receive nonlabor income. Such couples constitute more than half of the sample.

Family expenditure on the conditioning good can be a measure of the division of bargaining power within the family because it is influenced by intrahousehold bargaining. An instrument for family expenditure which is not codetermined with the labor supply decisions can reflect the distribution of bargaining power in the family. Unlike nonlabor income, expenditure on the conditioning goods is positive for over 95 percent of the households in the sample. However, it cannot be easily related to the bargaining power of one of the spouses. In some families when the wife's bargaining power increases the family spends more on clothing. In other families a large portion of the family clothing expenditure may consist of expenditure on the husband's or the children's clothing. Similarly, it is hard to relate the household expenditure on food at home or in restaurants to the bargaining power of one of the spouses. I do not find a statistically significant effect of the family expenditure on any of the conditioning goods on the wife's labor supply. [24]

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[24] I do not find that the family expenditure on the conditioning goods affects the wife's labor supply, based on the bootstrap standard errors. I report the bootstrap standard errors, because the wife's hour of work estimation involves both sample selection and endogeneity corrections. I also compute standard errors for the instrumental variable estimator, which ignore the estimation error due to the sample selection correction. The family expenditure on clothing affects the wife's hours of work when the standard errors for the instrumental variable estimator are used.

I employ the model without the conditioning good, and include the distribution factor s and its interaction with the indicator of being married as the measures of intrahousehold bargaining. If the unitary model holds, the wife's contribution to exogenous income should not affect the wife's hours of work. [25] I allow for the women's bargaining power to affect her labor supply differently in married and cohabiting couples. The results are displayed in Table 19. I assume that the wife's wage is exogenous, based on the result of the Hausman test, and report the standard errors corrected for sample selection. The distribution factor and its interaction with the indicator of being married affect the wife's hours of work at the 1-percent significance level. I find a different effect of the change in the distribution of bargaining power among the spouses on the wife's weekly hours of work in married and cohabiting partners. In married couples, women that contribute a greater share to exogenous family income work less. In cohabiting couples, women that contribute a greater share to exogenous family income work more. One interpretation of these results is that married women feel more secure about their future and their income and can afford to increase their leisure when they gain greater decision-making power in the family. In contrast, cohabiting women are less certain about their future with their partner, and, when their barging power increases, they use it to invest more into their career and work longer hours.

1.6.5 Results for 2007 and 2009

I estimate the wife's labor supply model with a conditioning good using the samples of couples interviewed in 2007 and 2009. As in the estimation based on the 2005 sample, I fit the model with three choices of the conditioning goods.

Table 21 shows the wife's labor supply elasticities for all choices of the conditioning goods and all years of analysis. I present both the OLS estimates and the results using instrumental variable estimation (IV). According to the IV results, the wife's hours wage elasticity in the 2007 and 2009 samples is lower than in the 2005 sample, and, similarly, not statistically significant. In the 2009 sample the wife's hours wage elasticity is even negative. The wife's hours income elasticity in the 2007–2009 samples is between -0.05 and -0.08, and only significantly different from 0 in the 2007

[25] I test the unitary model in the context of the wife's labor force participation decision. I do not find any effect of the distribution factor on the wife's labor force participation decision.

sample. The 2007–2009 recession with the rise in unemployment rates may have contributed to the lower responsiveness of the wife's labor supply to the changes in exogenous income in the 2009 sample. The wife's hours of work do not appear to be elastic with respect to the three conditioning goods.

Table 22 contains a summary of the results from testing the restrictions of the collective model for all years and model specifications. The restrictions of the collective model are not rejected for any choices of the conditioning good and years of analysis.

1.6.6 Sensitivity Analysis of the Wife's Labor Supply Elasticities

In this section, I examine whether the estimates of the wife's labor supply elasticities are sensitive to the changes in the variables of the model and the estimation sample. My estimate of the wife's hours wage elasticity using the collective labor supply model with a conditioning good and the 2005–2009 samples is lower than the estimates found in the literature based on the U.S. data before 2000. My estimate of the wife's hours wage elasticity is below 0.09 and not statistically significant. My estimate of the exogenous income elasticity of the wife's hours of work is -0.07—more than two times smaller in absolute value than the median estimates based on the data before 2000 (Killingsworth and Heckman, 1987; Blundell and Macurdy, 1999). To assess the robustness of these estimates, I estimate the wife's hours of work with a varying set of variables and the estimation samples.

Table 20 displays the results of the sensitivity analysis. All regressions include the variables used in conventional labor supply models: the wife's wage, exogenous income, proxies for the number of children, [26] and the number of adults in the family. The conditioning good is excluded. Its presence does not substantially affect the wife's labor supply elasticities (see section 6.3). In all regressions I account for sample selection and possible endogeneity of the wife's wage rate.

I estimate the wife's hours of work with two choices of dependent variable: the wife's average weekly hours of work, and her total hours of work per year. Most studies surveyed in Killingsworth and Heckman (1987) and Blundell and Macurdy (1999) examine the women's yearly hours of work.

[26] The independent variables related to the number of children are the number of children born two years before and family need two years before.

Women may have greater flexibility in the choice of weeks of work per year than in the choice of hours of work per week.

The first estimates in Table 20 come from the benchmark model discussed in section 6.3. The benchmark model includes six independent variables in addition to the independent variables listed above: the indicator variables reflecting the wife's college education, the years that the couple has been together, and the wife's first job. All of these variables are significant predictors of the wife's hours of work, and are included in the wife's labor supply estimation. I argue that women have different hours of work preferences if they have a college degree and if their first full–time job was in a professional, versus in a services industry. The number of years that the couple has been together may affect the roles of the spouses in the decision-making process.

The additional variables are not typical in traditional labor supply literature. Many empirical studies of labor supply, for instance Blundell et al. (1998) and Donni and Moreau (2007), exclude education from the hours of work equation and use it as an instrument in the wage equation. The second row in Table 20 displays estimates when the additional variables are excluded. The wife's hours wage elasticity increase from 0.07 in the benchmark model to 0.14, and becomes statistically significant. The wife's hours income elasticity also increases in magnitude from -0.08 to -0.10. The main predictor of the wife's hours of work in magnitude is the indicator of the wife's college education. This variables is also correlated with the wife's wage and nonwife income. The exclusion of this variable and the other additional variables increases the estimated the positive effect of the wife's wage and the negative effect of nonwife income on the wife's hours of work. However, the increase is not large in magnitude. The wife's hours wage elasticity of 0.14 is still lower than the median estimates based on the data before 2000 (Killingsworth and Heckman, 1987; Blundell and Macurdy, 1999). When I exclude the square and interaction terms of the wife's wage and nonwife income, the elasticities remain statistically significant, but do not increase in magnitude. Under all other specifications in the sensitivity analysis the wife's hours wage elasticity is not statistically significant.

I discuss in section 6.4 that women in married and unmarried couples are different in their labor supply behavior and motivations. To account for this difference, I estimate the wife's hours of work for married couples only, which constitute 73 percent of the sample. The resulting elasticities are similar to the estimates from the main sample. When I include the couples with men working part time (additional 4 percent of the sample), the wife's hours wage elasticity drops to 0.008, not precisely estimated.

A possible explanation for the low wage elasticity of the wife's weekly hours of work is that weekly hours of work are less flexible than yearly hours of work. I address this possibility by estimating the wife's hours of work equation with the wife's hours of work per year as the dependent variable. I find smaller but not statistically significant wife's hours wage elasticity, compared to the estimate with weekly hours of work. Including couples with women that work part of the year does not lead to higher wife's hours wage elasticity. These results hold for married and cohabiting couples, as well as for married couples only. The wife's yearly hours of work are slightly more responsive to changes in nonwife income than her weekly hours of work, especially when the couples with women that working part of the year are included in the sample.

The sensitivity analysis demonstrates that my low estimates of the wife's labor supply elasticities are not caused by the use of independent variables not typically used in other labor supply studies or by the functional form of the independent variables. Not are they the results of looking at weekly and not yearly hours of work. The particular estimation sample does not appear to drive the wife's hours of work elasticities either. I conclude that married and cohabiting women in the U.S. have become less responsive to their wage and exogenous income in their hours of work behavior since 2000, approaching the labor supply behavior of married men.

1.7 Summary and Discussion of the Results

In this paper I estimate the labor supply of married and cohabiting women using the unitary and the collective models of household labor supply. The collective model, based on Donni and Moreau (2007), incorporates the household expenditure on a good, called the conditioning good, into the wife's labor supply equation to reflect the distribution of the decision-making power within the household.

My study is different from Donni and Moreau (2007) in several respects. Firstly, I incorporate a test of the unitary model into the framework of Donni and Moreau's model. I test and reject the unitary model, and then estimate and test the collective model. The restrictions of the collective model are not rejected. This process allows me to identify the model that describes best the labor supply of married and cohabiting women in the U.S. during 2004–2008. [27]

Secondly, I test whether the household expenditure on the conditioning goods contains sufficient information about the distribution of bargaining power within the household. Donni and Moreau (2007) only discuss the properties that the conditioning goods should have, but do not test whether their chosen conditioning goods possess these properties. My tests demonstrate that the conditioning goods used in this paper: food at home, clothing, and food at restaurants, have the necessary properties.

Thirdly, I estimate the labor supply elasticities of married and cohabiting women under a wide set of modeling and sampling specifications. I estimate the elasticities under the unitary and the collective models, look at the elasticities of weekly as well as of yearly hours of work, exclude the independent variables not typically used in other labor supply studies, and vary the estimation sample based on marital status of the couples and the labor force participation statuses of the spouses. I find that my estimated elasticities are much lower than the estimates of Donni and Moreau (2007), and robust to the specification choices described above.

This study is based on the data from the 2005, 2007, and 2009 Panel Study of Income Dynamics. I estimate low and declining labor supply elasticities of married and cohabiting women, as do Blau and Kahn (2005) and Heim (2007), who use the data from the Current Population Survey for 1980–2000 and 1978–2002, respectively. However, unlike these authors, I fit a structural, and not a reduced form model, and, due to the richness of the PSID dataset, am able to perform an extensive sensitivity analysis to assess the robustness of my estimates to modeling and sampling specifications. My estimates, based on more recent data than Blau and Kahn (2005) and Heim (2007), continue the trend of shrinking elasticities of labor supply of married and cohabiting women found by these authors.

I perform a test of the unitary model of household decision making using the share of exogenous income received by the wife and its interaction with the indicator of being married for the couple

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[27] The unitary model may have described the labor supply choices of couples in the past better than it describes household labor supply based on the 2004–2008 data. Further research is needed to investigate this question.

as distribution factors. The distribution factors affect the wife's labor supply, which is inconsistent with the unitary model. This result supports the studies by Blundell et al. (2007) and Chiappori et al. (2002), among others, in showing that the roles of the individuals in the family are important in the household labor supply decisions. In addition to producing results inconsistent with the unitary model, the test provides insight into the decision-making process within married and cohabiting couples. The results of the test show that in married couples an increase in the wife's bargaining power, reflected by the increase in her contribution to the exogenous family income, leads to a decrease in her weekly hours worked. In unmarried cohabiting couples, higher bargaining power of the woman leads to an increase in her hours worked. My study points to the need for further research in the differences in intrahousehold decision making for married and unmarried couples.

I compute elasticities of the wife's labor supply from the estimated model. The summary of my results for all choices of the conditioning goods and three years of analysis is provided in Table 20. The wife's labor supply elasticity with respect to her own wage is below 0.09 and not significantly different from zero. In the 2009 sample the wife's own wage elasticity of labor supply is negative, although imprecisely estimated. The wife's labor supply elasticity with respect to exogenous income is between -0.05 and -0.12 and significant for most modeling and sample specifications. My estimates of the wife's labor supply elasticities are lower in absolute value than the estimates of elasticities in the literature. For instance, studies surveyed in Blundell and Macurdy (1999) report the wife's hours wage elasticity of 0.77 and hours income elasticity of -0.175 for the median study.

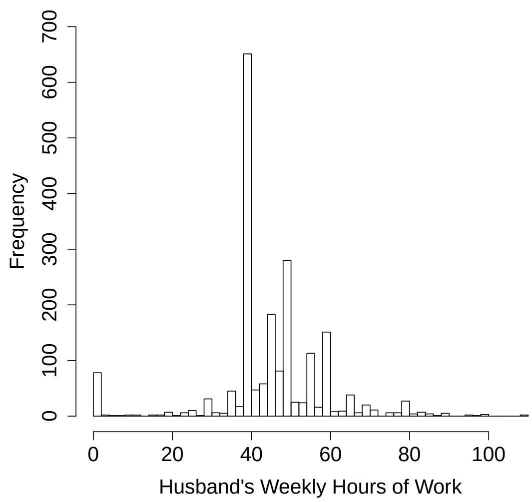
My results have implications for public policy. A small wage elasticity means that a unit increase in the income tax rate does not cause married and cohabiting women to reduce their weekly hours of work to a large extent. By the same token, the government cannot stimulate the labor supply of married and cohabiting women by very much through an income tax break. The similarly small but statistically significant wife's hours income elasticity implies that an increase in the government transfers to families leads to a decrease in the wife's hours of work, but the effect is small. Government transfers to families also act as a tax on earnings, because they are higher for families with lower earnings. However, the "tax" effect of government transfers on the women's labor supply in couples is small, because of the small women's wage elasticity. Taxes on the women's income and government transfers to families lead to small deadweight losses due to decreased hours of work of married and cohabiting women.

1.8 Tables and Figures

1.8.1 Descriptive Figures and Tables for Couples Interviewed in 2005

Figure 1.1: Husband's and Wife's Weekly Hours of Work. The Sample Includes 2008 Couples Interviewed in 2005.

(a) Husband's Hours of Work



(b) Wife's Hours of Work

Table 1.1: Employment and Weekly Hours of Work for Husbands and Wives

	Wife Does Not Work Year-Round	Wife Works Year-Round	Proportion of Wives Working
Husband does not work year-round	56	104	0.65
Husband works year-round but not full-time	17	49	0.74
Husband works full-time, year-round	471	1311	0.74
Proportion of husbands working year-round	0.89	0.93	
Proportion of husbands working full-time, year-round	0.87	0.90	

Notes: The sample consists of 2008 couples interviewed in 2005, with husband and wife ages 19–61 that do not receive transfer income. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

Table 1.2: Variables of the Wife's Labor Supply Estimation

Variable	Description
Variables in the wife's hours of work equation	
Wife's hours	Wife's average weekly hours of work in previous year
Wife's wage	Wife's average hourly earnings in previous year
Nonwife income[1]	Exogenous income of the household
Food	Average weekly food expenditure for meals at home
Clothing	Average weekly expenditure on clothing
Food at restaurants	Average weekly expenditure on food eaten away from home
Number of children born 2 years before	Children of both spouses or the husband only
Number of adults in the family unit	
Family needs 2 years before[2]	Needs per week for the family 2 years before the interview
Wife has a college degree	1 if the wife has a college degree
Couple was together 2 years before	1 if the couple was together 2 years before the interview
Wife's first job in a professional industry	1 if the wife's first full-time job was in a professional industry[3]
Wife's first job in arts, entertainment and recreation	
Wife's first job in accommodations and food services	
Inverse Mills ratio	A term included to correct the sample selection bias, computed from the wife's labor force participation equation
State fixed effects	State dummy variables for the states of residence of couples at the time of the interview.
S	Proportion of exogenous income coming from the wife, used as a proxy for the wife's bargaining power.
Instruments for wife's wage rate and the conditioning goods[4]	
Period	Time unit for the family expenditure on conditioning good. Expenditure is reported per week, two weeks, month, or year
Month of interview	Number of the month of current interview, ranging from 3 (March) to 10 (October)
Clothes tax	Tax rate on clothing in the state where the couple resides

[1] Nonwife income is defined as $\psi = y + \bar{h}w_m$, where y is nonlabor income of the couple, $\bar{h}$ is the husbands' fixed hours of work, and w_m is the husband's wage rate. $\bar{h}$ is set to the husbands' average hours of work of 47. Nonlabor income consists of interest, rent, and dividends of the husband and wife.

[2] This poverty threshold was taken from the table reported by the Census Bureau. The threshold depend on the size of the family and the number of related children under 18 years. Family needs serve as a proxy for the number of children in the family two years prior to the interview. I do not include the current number of children, because it may be endogenous to the couple's labor supply choices.

[3] Professional industries include information; finance and insurance; real estate, rental and leasing; professional, scientific, and technical services; management, administrative and support; and waste management services.

[4] For complete list of instruments, see Tables 6, 7, 12, and 15.

Table 1.3: Descriptive Statistics. Main Sample of Couples With Men Working Full-Time, Year-Round and Women Working Year-Round.

	Min	25 %	Med	Mean	SD	75 %	Max
Environmental characteristics							
Clothes tax	0.00	3.50	5.00	4.32	2.30	6.00	7.00
Family variables							
Nonwife income	10.18	66.72	93.96	117.70	96.89	140.67	1726.41
Nonlabor income	0.00	0.00	0.00	2.66	12.88	0.54	233.03
Food at home[1]	0.09	7.00	10.00	11.15	6.44	15.00	87.00
Clothing[1]	0.11	1.15	2.30	4.22	7.00	4.79	126.49
Food at restaurants[1]	0.04	2.30	4.00	5.32	4.79	6.00	50.00
Family needs in previous year	23.61	23.61	28.38	31.43	7.57	35.76	71.35
Husband's variables							
Average hours of work per week	35.00	40.00	45.00	48.10	10.53	51.00	110.00
Hourly wage	0.17	1.09	1.56	1.86	1.20	2.27	10.85
Age	21.00	35.00	43.00	42.09	9.64	50.00	60.00
Years of schooling	0	12	13	13.43	2.37	16	17
Wife's variables							
Average hours of work per week	1.00	35.00	40.00	39.07	11.76	43.00	112.00
Hourly wage	0.17	1.09	1.56	1.86	1.21	2.28	10.85
Age	20.00	32.00	41.00	40.24	9.63	48.00	59.00
Years of schooling	0.00	12.00	14.00	13.74	2.26	16.00	17.00

Notes: The sample consists of 1311 couples in which women work year-round, and men work full-time, year-round. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week. All variables including hours or work, household expenditure, and income reflect values per week. All monetary variables are measured in tens of dollars.

[1] The summary statistics for the expenditure on the conditioning goods are calculated for the sample that excludes couples with 0 expenditure.

1.8.2 Results for Year 2005. Wife's Labor Supply Estimation.

Sample Selection Correction

Table 1.4: Wife's Labor Force Participation Probit. Dependent Variable Is 1 If the Wife Works Year-Round.

	Estimate∗100	Std. Error∗100	T-Value	Pr (>|t|)
Nonwife income	−0.13	0.03	−4.17	0.000
Child age 5-18 present	17.95	10.19	1.76	0.078
Wife's age is 19-24	−61.30	21.74	−2.82	0.005
Wife's age is 25-29	−42.73	17.79	−2.40	0.016
Wife's age is 30-34	−40.49	17.84	−2.27	0.023
Wife's age is 35-39	−42.88	18.59	−2.31	0.021
Wife's age is 40-44	−36.09	18.78	−1.92	0.055
Wife's age is 45-49	20.66	16.54	1.25	0.212
Wife's age is 50-54	26.29	16.91	1.56	0.120
Husband is black	91.67	25.66	3.57	0.000
Wife is black	−23.67	31.61	−0.75	0.454
Wife is Asian	112.48	54.36	2.07	0.039
Wife is Christian	−21.66	11.30	−1.92	0.055
Wife is Protestant	21.52	8.38	2.57	0.010
Wife's years of schooling	10.80	1.60	6.73	0.000
Wife has a high school degree	6.01	1.93	3.12	0.002
Number of adults in family unit	27.05	7.19	3.76	0.000
Family needs 2 years before	−3.04	0.67	−4.51	0.000
Husband is divorced, separated,or widowed	70.28	29.81	2.36	0.018
Couple was together 2 years before	−38.36	14.01	−2.74	0.006
Couple is young and together for 2 years	54.32	10.93	4.97	0.000
Wife's first job in administrative support	27.29	9.21	2.96	0.003
Wife's first job in sales	44.81	15.22	2.94	0.003
Wife's first job in personal care	−80.88	52.58	−1.54	0.124
Wife's first job in a professional industry	−20.51	9.93	−2.07	0.039
Wife's first job in arts, entertainment and recreation	59.25	32.18	1.84	0.066
Wife is black × wife is Protestant	−57.20	24.87	−2.30	0.021
Wife is Asian × wife is Christian	−172.30	63.91	−2.70	0.007

Notes: The sample consists of 1782 couples in which men work full-time, year-round, and expenditure on food is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.
All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. The regression includes interaction terms of nonwife income with the wife's first full-time job indicators.

Conditioning Good Is Food at Home

Table 1.6: Wife's Wage Estimation. Dependent Variable Is Wife's Hourly Wage Rate

	Estimate∗100	Std. Error∗100[1]	T-Value	Pr (>|t|)
Nonwife income	1.20	0.29	4.09	0.000
Nonwife income$^2 \cdot 10^5$	−165.16	0.00	−2.89	0.004
Wife's age	10.00	2.59	3.87	0.000
Wife's age^2	−0.11	0.03	−3.34	0.001
Family needs 2 years before	−2.05	0.40	−5.14	0.000
Wife's years of schooling	−26.98	10.61	−2.54	0.011
Wife's years of schooling^2	1.92	0.50	3.89	0.000
Wife has a high school degree	−1.58	2.02	−0.78	0.435
Wife's some college	−25.20	10.96	−2.30	0.022
Wife has a college degree	−53.16	22.93	−2.32	0.021
Years of schooling of wife's mother	3.33	1.29	2.58	0.010
Family resides in an urban area	16.20	6.42	2.52	0.012
Husband lives in the state where he grew up	11.44	11.46	1.00	0.318
Inverse Mills ratio	34.09	16.40	2.08	0.038

Notes: The sample consists of 1304 couples in which women work year-round, men work full-time, year-round, and expenditure on food is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. Income, expenditure, and the family needs threshold are values per week. The regression includes dummy variables for the state of residence of the couple at the time of the interview, and interactions of the state dummy variables with nonwife income and its square.

[1] I provide the standard errors for the Heckman (1979) sample selection model.

Table 1.7: Food Expenditure Estimation. Dependent Variable Is the Family Expenditure on Food.

	Estimate∗100[1]	Std. Error∗100[1]	T-Value	Pr (>|t|)
Nonwife income	1.01	1.63	0.63	0.532
Nonwife income$^2 \cdot 10^5$	21.79	335.89	0.06	0.948
Family needs 2 years before	27.70	2.09	13.26	0.000
Wife is black	−171.50	89.97	−1.92	0.055
Food period is 2 weeks	−139.17	176.75	−0.80	0.422
Food period is month	−449.24	85.81	−5.40	0.000
Food period is year	−1169.78	137.76	−8.49	0.000
Family resides in an urban area	87.11	36.77	2.37	0.018
Husband has a high school degree	29.18	9.05	3.22	0.001
Wife has a college degree	82.97	36.47	2.27	0.023
Years of schooling of husband's mother	−32.83	6.81	−4.81	0.000
Inverse Mills ratio	−132.56	85.82	−1.55	0.120
Testing the existence of the conditional labor supply				
S (proportion of exogenous income coming from the wife)	−2194.24	1035.02	−2.12	0.034
S × couple is married	2805.24	1137.55	2.47	0.014

Notes: The sample consists of 1304 couples in which women work year-round, men work full-time, year-round, and expenditure on food is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. Income, expenditure, and the family needs threshold are values per week. The regression includes dummy variables for the state of residence of the couple at the time of the interview, and interactions of the state dummy variables with nonwife income and its square.

The variables s and its interaction with the indicator of the couple's marital status (s × couple is married) are not included in the first stage of the instrumental variable estimation. They are included when testing for the existence of the conditional labor supply representation with food at home as the conditioning good.

[1] I provide the standard errors for the Heckman (1979) sample selection model.

Table 1.8: Wife's Labor Supply Estimation by Instrumental Variable Regression. Dependent Variable Is Wife's Weekly Hours of Work. Food Is the Conditioning Good.

	Estimate∗100	Std. Error∗100[1]	T-Value	Pr (>|t|)
Wife's wage	40.03	484.39	0.08	0.934
Nonwife income	−1.74	3.05	−0.57	0.569
Food	−46.89	42.27	−1.11	0.267
Wife's wage^2	4.35	95.24	0.05	0.964
Nonwife income$^2 \cdot 10^5$	58.09	740.68	0.08	0.938
Food^2	0.97	1.21	0.81	0.420
Wife's wage × nonwife income	0.39	1.53	0.26	0.798
Wife's wage × food	0.27	21.03	0.01	0.990
Nonwife income × food	−0.07	0.19	−0.37	0.710
Number of children born 2 years before	−412.87	154.29	−2.68	0.008
Number of adults in family unit	257.59	74.37	3.46	0.001
Wife's age	−24.29	24.67	−0.98	0.325
Wife's age is 19-24	−1084.24	851.37	−1.27	0.203
Wife's age is 25-29	−794.52	758.81	−1.05	0.295
Wife's age is 30-34	−429.84	653.65	−0.66	0.511
Wife's age is 35-39	−340.41	533.83	−0.64	0.524
Wife's age is 40-44	−305.28	418.51	−0.73	0.466
Wife's age is 45-49	−261.00	317.31	−0.82	0.411
Wife's age is 50-54	−278.24	220.62	−1.26	0.207
Family needs in previous year	−12.42	7.50	−1.66	0.098
Wife has a college degree	937.18	376.77	2.49	0.013
Couple was together 2 years before	−224.78	109.24	−2.06	0.040
Wife has a college degree × family needs 2 years before	−26.33	11.67	−2.26	0.024
Wife's first job in a professional industry	239.77	96.86	2.48	0.013
Wife's first job in arts, entertainment and recreation	434.85	381.36	1.14	0.254
Wife's first job in accommodations and food services	252.37	120.22	2.10	0.036
Inverse Mills ratio	−589.01	230.63	−2.55	0.011

Elasticities

	Min	25 %	Med	Mean	SD	75 %	Max	SE[2]	P-Value[2]
Wife's wage	0.004	0.031	0.049	0.083	0.164	0.082	3.190	0.089	0.352
Nonwife income	−10.220	−0.062	−0.038	−0.073	0.318	−0.026	0.619	0.040	0.065
Food	−5.729	−0.099	−0.078	−0.105	0.229	−0.060	2.306	0.087	0.227

Notes: The sample consists of 1304 couples in which women work year-round, men work full-time, year-round, and expenditure on food is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. Income, expenditure, and the family needs threshold are values per week. The regression includes dummy variables for the state of residence of the couple at the time of the interview.

[1] The standard errors are bootstrapped to account for sample selection and instrumental variable estimation.

[2] I calculate the standard errors and p-values under the null hypothesis that elasticity is 0 using the Delta method (Weisberg, 2005), and present these statistics for the mean observation.

Table 1.9: Testing the Endogeneity of Food and Wife's Wage Rate

	Estimate∗100	Std. Error∗100[1]	T-Value	Pr (>|t|)
Wife's wage	−110.51	134.32	−0.82	0.411
Nonwife income	−0.74	1.04	−0.72	0.473
Food	−31.90	19.63	−1.63	0.104
Wife's wage^2	−9.18	21.16	−0.43	0.665
Nonwife income$^2 \cdot 10^5$	5.74	77.67	0.07	0.941
Food^2	0.31	0.75	0.42	0.678
Wife's wage × nonwife income	0.58	0.28	2.10	0.036
Wife's wage × food	11.71	5.73	2.04	0.041
Nonwife income × food	−0.14	0.05	−2.76	0.006
Number of children born 2 years before	−404.33	143.49	−2.82	0.005
Number of adults in family unit	240.15	62.66	3.83	0.000
Wife's age	−24.14	21.99	−1.10	0.272
Wife's age is 19-24	−1105.63	763.69	−1.45	0.148
Wife's age is 25-29	−804.13	666.29	−1.21	0.228
Wife's age is 30-34	−431.43	560.82	−0.77	0.442
Wife's age is 35-39	−351.29	456.43	−0.77	0.442
Wife's age is 40-44	−289.76	351.54	−0.82	0.410
Wife's age is 45-49	−285.35	258.15	−1.11	0.269
Wife's age is 50-54	−283.85	184.63	−1.54	0.124
Family needs 2 years before	−14.24	6.70	−2.12	0.034
Wife has a college degree	1130.72	304.92	3.71	0.000
Couple was together 2 years before	−211.35	106.88	−1.98	0.048
Wife has a college degree × family needs 2 years before	−32.01	9.36	−3.42	0.001
Wife's first job in a professional industry	256.67	87.93	2.92	0.004
Wife's first job in arts, entertainment and recreation	439.03	223.49	1.96	0.050
Wife's first job in accommodations and food services	292.47	99.27	2.95	0.003
Inverse Mills ratio	−606.81	192.54	−3.15	0.002
Residual from wife's wage equation	−16.08	86.32	−0.19	0.852
Residual from food equation	21.82	14.10	1.55	0.122
Residual from wife's wage equation^2	−21.44	25.02	−0.86	0.392
Residual from food equation^2	−0.15	1.02	−0.15	0.884
Residual from wife's wage equation × residual from food equation	−23.09	8.72	−2.65	0.008

Notes: The sample consists of 1304 couples in which women work year-round, men work full-time, year-round, and expenditure on food is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. The regression includes dummy variables for the state of residence of the couple at the time of the interview.

I jointly test the significance of the residuals from the wife's wage and food equations, their squares and their interaction term. Exogeneity of the wife's wage rate cannot be rejected. Exogeneity of food expenditure is rejected at 3-percent level.

[1] I provide the standard errors for the Heckman (1979) sample selection model.

Table 1.10: Testing the Endogeneity of Food and Wife's Wage Rate. A Model Without the Squares of Endogenous Variables and Their Interaction Term.

	Estimate∗100	Std. Error∗100[1]	T-Value	Pr (>|t|)
Wife's wage	−10.45	92.94	−0.11	0.911
Nonwife income	−1.70	0.87	−1.95	0.052
Food	−13.07	14.53	−0.90	0.369
Nonwife income$^2 \cdot 10^5$	6.96	67.70	0.10	0.918
Wife's wage × nonwife income	0.58	0.15	3.83	0.000
Nonwife income × food	−0.07	0.03	−2.05	0.041
Number of children born 2 years before	−404.28	143.85	−2.81	0.005
Number of adults in family unit	248.65	62.86	3.96	0.000
Wife's age	−22.32	22.05	−1.01	0.312
Wife's age is 19-24	−1035.55	766.17	−1.35	0.177
Wife's age is 25-29	−730.52	668.42	−1.09	0.275
Wife's age is 30-34	−375.73	562.70	−0.67	0.504
Wife's age is 35-39	−314.43	458.03	−0.69	0.493
Wife's age is 40-44	−279.31	352.67	−0.79	0.428
Wife's age is 45-49	−262.05	258.81	−1.01	0.311
Wife's age is 50-54	−277.38	185.62	−1.49	0.135
Family needs 2 years before	−14.30	6.68	−2.14	0.032
Wife has a college degree	1011.74	302.04	3.35	0.001
Couple was together 2 years before	−210.19	107.57	−1.95	0.051
Wife has a college degree × family needs 2 years before	−28.26	9.27	−3.05	0.002
Wife's first job in a professional industry	247.32	88.27	2.80	0.005
Wife's first job in arts, entertainment and recreation	408.29	224.10	1.82	0.069
Wife's first job in accommodations and food services	277.05	99.25	2.79	0.005
Inverse Mills ratio	−621.24	193.01	−3.22	0.001
Residual from wife's wage equation	−62.74	84.92	−0.74	0.460
Residual from food equation	28.02	13.74	2.04	0.042

Notes: The sample consists of 1304 couples in which women work, men work more than 35 hours per week, and expenditure on food is not 0. All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. The regression includes dummy variables for the state of residence of the couple at the time of the interview.

[1] I provide the standard errors for the Heckman (1979) sample selection model.

Table 1.11: Testing the Restrictions of the Collective Model. Estimates From the Wife's Labor Supply Regression With Food as the Conditioning Good.

Restriction (H_0)	Estimate	Std. Error[1]	P-Value[1]
$2a_{33}a_{12} - a_{13}a_{23} = 0$	$7.818 * 10^{-5}$	$11.012 * 10^{-5}$	0.478
$a_{23}a_{23} - 4a_{22}a_{33} = 0$	$0.027 * 10^{-5}$	$0.086 * 10^{-5}$	0.757
$2a_{33}a_{12} - a_{13}a_{23} - a_{23}a_{23} + 4a_{22}a_{33} = 0$	$7.792 * 10^{-5}$	$10.965 * 10^{-5}$	0.477
$\left(a_{01} - \frac{a_{03}a_{02}}{2a_{33}}\right) + 2\left(a_{11} - \frac{a_{13}^2}{4a_{33}}\right) w_f - \left(a_{02} - \frac{a_{03}a_{23}}{2a_{33}}\right) h_f > 0$	1.966	2.012	0.836

Notes: The sample consists of 1304 couples in which women work year-round, men work full-time, year-round, and expenditure on food is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week. The parameter estimates are taken from the estimation of the wife's labor supply by instrumental variable regression (Table 8).

[1] I calculate the standard errors and p-values under the null hypothesis that elasticity is 0 using the Delta method (Weisberg, 2005). The last restriction is dependent on individual couple characteristics, w_f and h_f, and cannot be tested globally. The restriction holds (the estimate is positive) for all observations, and the standard error and the p-value are presented for the mean estimate.

Table 1.5: Wife's Labor Supply Estimation. Dependent Variable Is Wife's Weekly Hours of Work. Food Is the Conditioning Good.

	Estimate∗100	Std. Error∗100[1]	T-Value	Pr (>|t|)
Wife's wage	−8.26	81.95	−0.10	0.920
Nonwife income	−1.66	0.88	−1.90	0.058
Food	−1.14	11.73	−0.10	0.923
Wife's wage^2	−22.64	12.91	−1.75	0.080
Nonwife income$^2 \cdot 10^5$	36.69	64.94	−0.56	0.572
Food^2	0.29	0.21	1.39	0.165
Wife's wage × nonwife income	0.86	0.19	4.52	0.000
Wife's wage × food	2.65	4.06	0.65	0.514
Nonwife income × food	−0.11	0.04	−2.98	0.003
Number of children born 2 years before	−382.83	142.92	−2.68	0.007
Number of adults in family unit	236.44	62.09	3.81	0.000
Wife's age	255.96	96.29	2.66	0.008
Wife's age^2	−3.41	1.16	−2.95	0.003
Wife's age is 19-24	−852.13	763.89	−1.12	0.265
Wife's age is 25-29	−983.48	672.16	−1.46	0.144
Wife's age is 30-34	−990.46	601.22	−1.65	0.100
Wife's age is 35-39	−1126.26	539.39	−2.09	0.037
Wife's age is 40-44	−1133.02	461.72	−2.45	0.014
Wife's age is 45-49	−983.51	360.66	−2.73	0.006
Wife's age is 50-54	−710.47	239.71	−2.96	0.003
Family needs 2 years before	−20.31	6.04	−3.36	0.001
Wife has a college degree	1001.72	299.10	3.35	0.001
Couple was together 2 years before	−235.38	107.30	−2.19	0.028
Wife has a college degree × family needs 2 years before	−28.00	9.30	−3.01	0.003
Wife's first job in a professional industry	248.73	87.97	2.83	0.005
Wife's first job in arts, entertainment and recreation	424.33	224.13	1.89	0.059
Wife's first job in accommodations and food services	292.63	99.29	2.95	0.003
Inverse Mills ratio	−625.28	191.65	−3.26	0.001

Elasticities

	Min	25 %	Med	Mean	SD	75 %	Max	SE[2]	P-Value[2]
Wife's wage	0.003	0.023	0.040	0.074	0.157	0.071	3.203	0.089	0.404
Nonwife income	−9.550	−0.060	−0.037	−0.070	0.299	−0.025	0.714	0.040	0.076
Food	−5.822	−0.097	−0.077	−0.103	0.230	−0.060	2.382	0.087	0.234

Notes: The sample consists of 1304 couples in which women work year-round, men work full-time, year-round, and expenditure on food is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. Income, expenditure, and the family needs threshold are values per week. The regression includes dummy variables for the state of residence of the couple at the time of the interview.

[1] I provide the standard errors for the Heckman (1979) sample selection model.

[2] I calculate the standard errors and p-values under the null hypothesis that elasticity is 0 using the Delta method (Weisberg, 2005), and present these statistics for the mean observation.

Conditioning Good Is Clothing

Table 1.12: Clothing Expenditure Estimation. Dependent Variable is the Family Expenditure on Clothing.

	Estimate∗100	Std. Error∗100[1]	T-Value	Pr (>|t|)
Clothes tax	−843.02	632.58	−1.33	0.183
Clothes tax^2	79.55	118.69	0.67	0.503
Clothing period is year	−329.21	3815.50	−0.09	0.931
Wife has a high school degree	18.34	9.75	1.88	0.060
Wife has a college degree	88.28	45.24	1.95	0.051
Years of schooling of husband's mother	14.94	8.30	1.80	0.072
Number of adults in family unit	72.18	31.67	2.28	0.023
Wife's age is 19-24	131.24	115.24	1.14	0.255
Wife's age is 25-29	104.70	88.61	1.18	0.238
Wife's age is 30-34	257.12	86.75	2.96	0.003
Wife's age is 35-39	173.26	86.38	2.01	0.045
Wife's age is 40-44	71.37	82.83	0.86	0.389
Wife's age is 45-49	191.88	84.84	2.26	0.024
Wife's age is 50-54	207.66	87.89	2.36	0.018
Nonwife income	3.09	2.20	1.40	0.160
Nonwife income$^2 \cdot 10^5$	−525.33	418.05	−1.26	0.209
Family resides in an urban area	150.03	51.64	2.91	0.004
Month of interview	25.14	11.74	2.14	0.032
Husband is black	167.54	112.01	1.50	0.135
Inverse Mills ratio	50.69	112.42	0.45	0.652
Testing the existence of the conditional labor supply				
S (proportion of exogenous income coming from the wife)	1673.67	518.63	3.23	0.001

Notes: The sample consists of 1226 couples in which women work year-round, men work full-time, year-round, and expenditure on clothing is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. Income, expenditure, and the family needs threshold are values per week. The regression includes dummy variables for the state of residence of the couple at the time of the interview, and interactions of the state dummy variables with nonwife income and its square. I further include four dummy variables indicating the largest city in the county, twelve variables reflecting the average temperatures in the state of residence during each month, and interactions of these terms with the dummy variables reflecting the reported period of expenditure.

The variable s is not included in the first stage of the instrumental variable estimation. It is included when testing for the existence of the conditional labor supply representation with clothing as the conditioning good.

[1] I provide the standard errors for the Heckman (1979) sample selection model.

Table 1.13: Wife's Labor Supply Estimation by Instrumental Variable Regression. Dependent Variable Is Wife's Weekly Hours of Work. Clothing Is the Conditioning Good.

	Estimate∗100	Std. Error∗100[1]	T-Value	Pr (>|t|)
Wife's wage	−38.06	686.28	−0.06	0.956
Nonwife income	−2.66	3.30	−0.81	0.420
Clothing	−45.38	61.09	−0.74	0.458
Wife's wage^2	1.35	115.95	0.01	0.991
Nonwife income$^2 \cdot 10^5$	175.25	640.49	0.27	0.784
Clothing^2	−0.29	1.60	−0.18	0.854
Wife's wage × nonwife income	−0.09	1.71	−0.05	0.958
Wife's wage × clothing	32.12	94.23	0.34	0.733
Nonwife income × clothing	−0.05	0.68	−0.08	0.937
Number of children born 2 years before	−428.63	165.73	−2.59	0.010
Number of adults in family unit	243.91	79.54	3.07	0.002
Wife's age	−18.11	27.46	−0.66	0.510
Wife's age is 19-24	−956.02	964.58	−0.99	0.322
Wife's age is 25-29	−643.35	847.33	−0.76	0.448
Wife's age is 30-34	−248.72	724.84	−0.34	0.732
Wife's age is 35-39	−248.73	582.41	−0.43	0.669
Wife's age is 40-44	−139.25	453.18	−0.31	0.759
Wife's age is 45-49	−146.58	358.44	−0.41	0.683
Wife's age is 50-54	−173.07	238.65	−0.73	0.468
Family needs 2 years before	−19.89	8.97	−2.22	0.027
Wife's years of schooling	23.09	41.31	0.56	0.576
Wife has a high school degree	28.88	24.50	1.18	0.239
Wife has a college degree	1053.45	354.49	2.97	0.003
Couple was together 2 years before	−339.77	236.92	−1.43	0.152
Wife has a college degree× family needs 2 years before	−31.10	10.79	−2.88	0.004
Wife's first job in a professional industry	234.32	107.93	2.17	0.030
Wife's first job in arts, entertainment and recreation	495.27	403.64	1.23	0.220
Wife's first job in accommodations and food services	212.53	154.40	1.38	0.169
Inverse Mills ratio	−396.53	382.09	−1.04	0.300

Elasticities

	Min	25 %	Med	Mean	SD	75 %	Max	SE[2]	P-Value[2]
Wife's wage	−0.133	−0.001	0.013	0.069	0.238	0.050	3.996	0.102	0.497
Nonwife income	−8.012	−0.101	−0.065	−0.105	0.287	−0.044	1.354	0.051	0.040
Clothing	−5.026	−0.008	−0.001	0.002	0.224	0.013	1.621	0.056	0.970

Notes: The sample consists of 1226 couples in which women work year-round, men work full-time, year-round, and expenditure on clothing is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. Income, expenditure, and the family needs threshold are values per week. The regression includes dummy variables for the state of residence of the couple at the time of the interview.

[1] The standard errors are bootstrapped to account for sample selection and instrumental variable estimation.

[2] I calculate the standard errors and p-values under the null hypothesis that elasticity is 0 using the Delta method (Weisberg, 2005), and present these statistics for the mean observation.

Table 1.14: Testing the Restrictions of the Collective Model. Estimates From the Wife's Labor Supply Regression, With Clothing as the Conditioning Good.

Restriction (H_0)	Estimate	Std. Error[1]	P-Value[1]
$2a_{33}a_{12} - a_{13}a_{23} = 0$	17.857 $*10^{-5}$	36.850 $*10^{-5}$	0.628
$a_{23}a_{23} - 4a_{22}a_{33} = 0$	0.050 $*10^{-5}$	0.135 $*10^{-5}$	0.711
$2a_{33}a_{12} - a_{13}a_{23} - a_{23}a_{23} + 4a_{22}a_{33} = 0$	17.808 $*10^{-5}$	36.719$*10^{-5}$	0.628
$\left(a_{01} - \frac{a_{03}a_{02}}{2a_{33}}\right) + 2\left(a_{11} - \frac{a_{13}^2}{4a_{33}}\right) w_f - \left(a_{02} - \frac{a_{03}a_{23}}{2a_{33}}\right) h_f > 0$	7.354	28.889	0.600

Notes: The sample consists of 1226 couples in which women work year-round, men work full-time, year-round, and expenditure on clothing is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week. The parameter estimates are taken from the estimation of the wife's labor supply by instrumental variable regression (Table 13).

[1] I calculate the standard errors and p-values under the null hypothesis that elasticity is 0 using the Delta method (Weisberg, 2005). The last restriction is dependent on individual couple characteristics, w_f and h_f, and cannot be tested globally. The restriction holds (the estimate is positive) for 680 of 1226 observations, and the standard error and the p-value are presented for the mean estimate.

Conditioning Good is Food at Restaurants

Table 1.15: Restaurant Food Expenditure Estimation. Dependent Variable Is the Family Expenditure on Food at Restaurants.

	Estimate∗100	SE∗100[1]	T-Value	Pr (>|t|)
Nonwife income	1.12	0.15	7.69	0.000
Family eats main meal together 2 days/week	−81.46	68.76	−1.18	0.236
Family eats main meal together 3 days/week	−112.02	68.85	−1.63	0.104
Family eats main meal together 4 days/week	−138.77	68.93	−2.01	0.044
Family eats main meal together 5 days/week	−165.86	68.16	−2.43	0.015
Family eats main meal together 6 days/week	−111.27	74.65	−1.49	0.136
Family eats main meal together 7 days/week	−192.14	64.73	−2.97	0.003
Child age 5-18 present	−61.73	27.64	−2.23	0.026
Family resides in an urban area	75.18	28.11	2.67	0.008
Wife is black	−140.83	39.56	−3.56	0.000
Food at restaurants period is 2 weeks	−205.45	173.63	−1.18	0.237
Food at restaurants period is month	−310.24	33.71	−9.20	0.000
Food at restaurants period is year	−504.02	113.31	−4.45	0.000
Wife's age is 19-24	5.68	75.30	0.08	0.940
Wife's age is 25-29	58.67	59.32	0.99	0.323
Wife's age is 30-34	56.41	58.02	0.97	0.331
Wife's age is 35-39	55.31	59.66	0.93	0.354
Wife's age is 40-44	86.07	57.83	1.49	0.137
Wife's age is 45-49	131.27	58.07	2.26	0.024
Wife's age is 50-54	145.98	58.08	2.51	0.012
Husband's years of schooling	18.15	5.77	3.15	0.002
Month of interview	28.78	7.70	3.74	0.000
Inverse Mills ratio	−113.49	71.01	−1.60	0.110
Testing the existence of the conditional labor supply				
S (proportion of exogenous income coming from the wife)	662.57	337.40	1.96	0.050

Notes: The sample consists of 1252 couples in which women work year-round, men work full-time, year-round, and expenditure on food at restaurants is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. Income, expenditure, and the family needs threshold are values per week. The regression includes dummy variables for the state of residence of the couple at the time of the interview, and interactions of the state dummy variables with nonwife income and its square.I further include twelve variables reflecting the average temperatures in the state of residence during each month, and interactions of race indicators with the dummy variables reflecting the reported period of expenditure.

The variable s is not included in the first stage of the instrumental variable estimation. It is included when testing for the existence of the conditional labor supply representation with food at restaurants as the conditioning good.

[1] I provide the standard errors for the Heckman (1979) sample selection model.

Table 1.16: Wife's Labor Supply Estimation by Instrumental Variable Regression. Dependent Variable Is Wife's Weekly Hours of Work. Food at Restaurants Is the Conditioning Good.

	Estimate∗100	Std. Error∗100[1]	T-Value	Pr (>|t|)
Wife's wage	236.73	886.69	0.27	0.790
Nonwife income	−5.09	5.31	−0.96	0.338
Food at restaurants	−2.29	90.72	−0.03	0.980
Wife's wage^2	−14.60	131.11	−0.11	0.911
Nonwife income$^2 \cdot 10^5$	−162.76	1231.20	−0.13	0.895
Food at restaurants^2	3.06	8.58	0.36	0.722
Wife's wage × nonwife income	0.68	1.99	0.34	0.733
Wife's wage × food at restaurants	−20.38	85.99	−0.24	0.813
Nonwife income × food at restaurants	0.25	1.05	0.24	0.813
Number of children born 2 years before	−343.95	187.97	−1.83	0.068
Number of adults in family unit	245.18	86.58	2.83	0.005
Wife's age	−38.92	32.76	−1.19	0.235
Wife's age is 19-24	−1430.80	1088.76	−1.31	0.189
Wife's age is 25-29	−1189.20	1001.57	−1.19	0.235
Wife's age is 30-34	−784.02	869.90	−0.90	0.368
Wife's age is 35-39	−627.08	681.60	−0.92	0.358
Wife's age is 40-44	−465.90	494.04	−0.94	0.346
Wife's age is 45-49	−442.49	449.67	−0.98	0.325
Wife's age is 50-54	−379.81	282.71	−1.34	0.179
Family needs 2 years before	−15.17	8.34	−1.82	0.069
Wife has a college degree	961.39	482.98	1.99	0.047
Couple was together 2 years before	−200.31	161.07	−1.24	0.214
Wife has a college degree × family needs 2 years before	−29.54	13.39	−2.21	0.028
Wife's first job in a professional industry	264.12	137.25	1.92	0.055
Wife's first job in arts, entertainment and recreation	466.54	430.64	1.08	0.279
Wife's first job in accommodations and food services	300.74	260.77	1.15	0.249
Inverse Mills ratio	−610.23	306.96	−1.99	0.047

Elasticities

	Min	25 %	Med	Mean	SD	75 %	Max	SE[2]	P-Value[2]
Wife's wage	−1.097	0.038	0.060	0.088	0.230	0.097	5.021	0.157	0.576
Nonwife income	−16.388	−0.110	−0.070	−0.123	0.515	−0.044	1.021	0.093	0.185
Restaurant food	−0.293	0.000	0.014	0.086	0.330	0.056	5.595	0.129	0.506

Notes: The sample consists of 1252 couples in which women work year-round, men work full-time, year-round, and expenditure on food at restaurants is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. Income, expenditure, and the family needs threshold are values per week. The regression includes dummy variables for the state of residence of the couple at the time of the interview.

[1] The standard errors are bootstrapped to account for sample selection and instrumental variable estimation.

[2] I calculate the standard errors and p-values under the null hypothesis that elasticity is 0 using the Delta method (Weisberg, 2005), and present these statistics for the mean observation.

Table 1.17: Testing the Restrictions of the Collective Model. Estimates From the Wife's Labor Supply Regression, With Food at Restaurants as the Conditioning Good.

Restriction (H_0)	Estimate	Std. Error[1]	P-Value[1]
$2a_{33}a_{12} - a_{13}a_{23} = 0$	92.073 $*10^{-5}$	282.956 $*10^{-5}$	0.745
$a_{23}a_{23} - 4a_{22}a_{33} = 0$	0.814 $*10^{-5}$	2.885 $*10^{-5}$	0.778
$2a_{33}a_{12} - a_{13}a_{23} - a_{23}a_{23} + 4a_{22}a_{33} = 0$	91.25$*10^{-5}$	280.150 $*10^{-5}$	0.745
$\left(a_{01} - \frac{a_{03}a_{02}}{2a_{33}}\right) + 2\left(a_{11} - \frac{a_{13}^2}{4a_{33}}\right) w_f -$ $\left(a_{02} - \frac{a_{03}a_{23}}{2a_{33}}\right) h_f > 0$	2.424	3.504	0.755

Notes: The sample consists of 1252 couples in which women work year-round, men work full-time, year-round, and expenditure on food at restaurants is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

The parameter estimates are taken from the estimation of the wife's labor supply by instrumental variable regression (Table 16).

[1] I calculate the standard errors and p-values under the null hypothesis that elasticity is 0 using the Delta method (Weisberg, 2005). The last restriction is dependent on individual couple characteristics, w_f and h_f, and cannot be tested globally. The restriction holds (the estimate is positive) for 1190 out of 1252 observations, and the standard error and the p-value are presented for the mean estimate.

No Conditioning Good (Benchmark Model)

Table 1.18: Wife's Labor Supply Estimation by Instrumental Variable Regression. Dependent Variable Is Wife's Weekly Hours of Work.

	Estimate∗100	Std. Error∗100[1]	T-Value	Pr (>|t|)
Wife's wage	38.68	365.41	0.11	0.916
Nonwife income	−3.06	1.89	−1.62	0.105
Wife's wage^2	5.33	84.40	0.06	0.950
Nonwife income$^2 \cdot 10^5$	78.62	397.66	0.20	0.843
Wife's wage × nonwife income	0.35	1.12	0.32	0.751
Number of children born 2 years before	−364.37	154.56	−2.36	0.019
Number of adults in family unit	237.23	70.47	3.37	0.001
Wife's age	−23.36	24.64	−0.95	0.343
Wife's age is 19-24	−1032.68	865.99	−1.19	0.233
Wife's age is 25-29	−753.74	762.10	−0.99	0.323
Wife's age is 30-34	−375.61	648.92	−0.58	0.563
Wife's age is 35-39	−323.18	523.68	−0.62	0.537
Wife's age is 40-44	−261.41	415.02	−0.63	0.529
Wife's age is 45-49	−235.09	308.94	−0.76	0.447
Wife's age is 50-54	−257.98	217.16	−1.19	0.235
Family needs 2 years before	−17.97	6.54	−2.75	0.006
Wife has a college degree	1052.35	342.62	3.07	0.002
Couple was together 2 years before	−235.76	107.15	−2.20	0.028
Wife has a college degree × family needs 2 years before	−30.53	10.37	−2.94	0.003
Wife's first job in a professional industry	238.88	95.31	2.51	0.012
Wife's first job in arts, entertainment and recreation	421.51	378.76	1.11	0.266
Wife's first job in accommodations and food services	242.28	111.88	2.17	0.031
Inverse Mills ratio	−620.34	235.37	−2.64	0.009
Testing the endogeneity of the wife's wage[1]				
Residual from wife's wage equation	−43.52	86.01	−0.51	0.613
Residual from wife's wage equation^2	−29.64	24.82	−1.19	0.232

Elasticities

	Min	25 %	Med	Mean	SD	75 %	Max	SE[2]	P-Value[2]
Wife's wage	0.002	0.022	0.038	0.071	0.148	0.068	3.020	0.077	0.354
Nonwife income	−7.608	−0.078	−0.052	−0.084	0.248	−0.038	0.745	0.034	0.014

Notes: The sample consists of 1311 couples in which women work year-round, and men work full-time, year-round. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.
All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. Income, expenditure, and the family needs threshold are values per week.

[1] In the Hausman test of endogeneity I include the wife's wage, its square, the residuals from the first stage of the wife's wage estimation, and the residual squared into the wife's hours of work regression. The residual terms do not affect the wife's hours of work, either individually, or jointly. Then, I cannot reject exogeneity of the wife's wage rate.

[2] The standard errors are bootstrapped to account for sample selection and instrumental variable estimation.

Table 1.19: Wife's Labor Supply Estimation With Distribution Factors. Dependent Variable Is Wife's Weekly Hours of Work.

	Estimate∗100	Std. Error∗100[1]	T-Value	Pr (>|t|)
Wife's wage	43.12	68.09	0.63	0.527
Nonwife income	−3.42	0.69	−4.93	0.000
Wife's wage^2	12.92	−1.81	0.071	
Nonwife income$^2 \cdot 10^5$	−36.95	64.63	−0.57	0.568
Wife's wage × nonwife income	0.84	0.19	4.46	0.000
Number of children born 2 years before	−383.98	141.98	−2.70	0.007
Number of adults in family unit	225.28	61.62	3.66	0.000
Wife's age	−24.42	21.86	−1.12	0.264
Wife's age is 19-24	−1097.75	761.75	−1.44	0.150
Wife's age is 25-29	−820.78	663.72	−1.24	0.216
Wife's age is 30-34	−416.44	558.45	−0.75	0.456
Wife's age is 35-39	−346.29	454.45	−0.76	0.446
Wife's age is 40-44	−285.52	350.11	−0.82	0.415
Wife's age is 45-49	−276.59	256.49	−1.08	0.281
Wife's age is 50-54	−256.84	184.56	−1.39	0.164
Family needs 2 years before	−18.78	5.83	−3.22	0.001
Wife has a college degree	1100.03	293.69	3.75	0.000
Couple was together 2 years before	−216.76	110.33	−1.96	0.050
Wife has a college degree × family needs 2 years before	−30.49	9.13	−3.34	0.001
Wife's first job in a professional industry	242.50	87.68	2.77	0.006
Wife's first job in arts, entertainment and recreation	436.02	224.05	1.95	0.052
Wife's first job in accommodations and food services	260.05	99.29	2.62	0.009
Couple is married	55.24	128.40	0.43	0.667
S (proportion of exogenous income coming from the wife)	6542.23	2144.13	3.05	0.002
S × couple is married	−7511.76	2342.41	−3.21	0.001
Inverse Mills ratio	−605.87	195.13	−3.11	0.002

Notes: The sample consists of 1311 couples in which women work year-round, and men work full-time, year-round. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week.

All monetary variables, such as wage, expenditure, and income, are measured in tens of dollars. Income, expenditure, and the family needs threshold are values per week.

The variable s and its interaction with the indicator of the couple's marital status (s × couple is married) are distribution factors reflecting the bargaining power of the wife. They are included as a test of the unitary model.

[1] I provide the standard errors for the Heckman (1979) sample selection model.

Table 1.20: Elasticities of Wife's Hours of Work Using Different Models and Samples

Model and Sample Specification	Wife's Hours of Work Elasticity Wage	Nonwife Income
Independent variables: All regressions include the wife's wage, nonwife income, variables related to the number of children and adults in the family, and inverse Mills ratio.		
Dependent variable is weekly hours of work		
Main sample[1] (N=1311)	0.07	−0.08 **
	(0.08)	(0.03)
Exclude wife's education and other variables not typical in the literature [2]	0.14 *	−0.10 ***
	(0.07)	(0.04)
Exclude the squares of wife's wage and nonwife income, and their interaction term	0.13 **	−0.05 ***
	(0.07)	(0.04)
Only married couples (N=957)	0.10	−0.11 ***
	(0.08)	(0.04)
Include men working part time (N=1363)	0.008	−0.05 *
	(0.08)	(0.03)
Dependent variable is yearly hours of work		
Benchmark model and main sample (N=1311)	0.04	−0.09 **
	(0.08)	(0.04)
Only married couples (N=957)	0.06	−0.11 ***
	(0.08)	(0.04)
Include women working part of the year (N=1481)	0.05	−0.13 ***
	(0.17)	(0.05)

Notes: All results are based on the instrumental variable estimation of the wife's labor supply without the conditioning good. The standard errors are given in parentheses. I calculate the standard errors under the null hypothesis that elasticity is 0 using the Delta method (Weisberg, 2005), and present them for the mean observation. *, **, and *** represent rejection of the null hypothesis that elasticity is 0 at the 10-percent, 5-percent levels, and 1-percent levels, respectively.

[1] The main sample consists of couples in which women work year-round, and men work full-time, year-round. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week. The results are taken from Table 18.

[2] The variables excluded from the wife's hours of work equation are dummy variables indicating whether the wife has a college degree and whether the couple was together 2 years before, and variables related to the wife's first full-time job.

1.8.3 Results for Years 2005–2009. Wife's Labor Supply Estimation.

Table 1.21: Elasticities of Wife's Weekly Hours of Work Using Different Conditioning Goods

	Food at Home Is Conditioning Good			Clothing Is Conditioning Good			Food at Restaurants Is Conditioning Good		
	Wage	Nonwife Income	Food	Wage	Nonwife Income	Clothing	Wage	Nonwife Income	Rest. Food
2005									
OLS	0.074	-0.070^{*}	-0.103	0.017	-0.089^{***}	0.005	0.019	-0.095^{***}	0.028
	(0.089)	(0.040)	(0.087)	(0.034)	(0.032)	(0.017)	(0.033)	(0.032)	(0.024)
IV	0.083	-0.073^{*}	-0.105	0.069	-0.105^{**}	0.002	0.088	-0.123	0.086
	(0.089)	(0.040)	(0.087)	(0.102)	(0.051)	(0.056)	(0.157)	(0.093)	(0.129)
2007									
OLS	0.007	-0.052^{*}	-0.040	0.005	-0.071^{***}	0.022	-0.012	-0.073^{***}	0.046^{**}
	(0.029)	(0.027)	(0.035)	(0.028)	(0.028)	(0.012)	(0.029)	(0.027)	(0.021)
IV	0.023	-0.064^{*}	-0.042	0.042	-0.062^{*}	-0.011	-0.019	-0.069^{*}	0.014
	(0.066)	(0.035)	(0.080)	(0.062)	(0.036)	(0.030)	(0.071)	(0.036)	(0.051)
2009									
OLS	0.019	-0.076^{***}	-0.035	0.007	-0.085^{***}	0.018	-0.003	-0.075^{**}	0.017
	(0.026)	(0.028)	(0.036)	(0.026)	(0.029)	(0.015)	(0.026)	(0.030)	(0.026)
IV	-0.071	-0.051	-0.063	-0.069	-0.076	0.052	-0.109	-0.057	-0.009
	(0.086)	(0.041)	(0.133)	(0.078)	(0.051)	(0.075)	(0.110)	(0.047)	(0.175)

Notes: The samples consists of couples in which work year-round, men work full-time, year-round, and expenditure on the conditioning good is not 0. Year-round employment is defined as working 36 weeks or more in a year, being unemployed no more than 28 days in a year, and being out of labor force no more than 4 weeks in a year. Full-time employment is defined as working 35 hours or more per week. The sample sizes are 1226–1400 in year 2005, 1200–1500 in year 2007, and 1090–1100 in 2009.
The standard errors are given in parentheses. I calculate the standard errors under the null hypothesis that elasticity is 0 using the Delta method (Weisberg, 2005), and present them for the mean observation. *, **, and *** represent rejection of the null hypothesis that elasticity is 0 at the 10-percent, 5-percent levels, and 1-percent levels, respectively.

Table 1.22: Testing the Restrictions of the Collective Model

	Food at Home Is Conditioning Good			Clothing Is Conditioning Good			Food at Restaurants Is Conditioning Good		
	R1	R2	R3	R1	R2	R3	R1	R2	R3
2005	7.818	0.027	1.966	17.857	0.050	7.354	92.073	0.814	2.424
	(11.012)	(0.086)	(2.012)	(36.850)	(0.135)	(28.889)	(282.956)	(2.88)	(3.504)
2007	0.832	−0.134	1.593	−2.263	−0.038	0.847	7.972	0.224	1.420
	(11.445)	(0.132)	(1.489)	(3.37)	(0.037)	(1.739)	(22.708)	(0.205)	(2.524)
2009	−6.730	0.103	0.430	68.110	0.408	128.181	−82.215	0.203	1.213)

Notes: The restrictions are defined as:
R1: $2a_{33}a_{12} - a_{13}a_{23} = 0$ (1.26)
R2: $a_{23}a_{23} - 4a_{22}a_{33} = 0$ (1.26)
R3: $\left(a_{01} - \frac{a_{03}a_{02}}{2a_{33}}\right) + 2\left(a_{11} - \frac{a_{13}^2}{4a_{33}}\right) w_f - \left(a_{02} - \frac{a_{03}a_{23}}{2a_{33}}\right) h_f > 0$ (1.27).
The samples consists of couples in which women work, men work more than 35 hours per week, and expenditure on the conditioning good is not 0. The sample sizes are 1226–1400 in year 2005, 1200–1500 in year 2007, and 1090–1100 in 2009. The standard errors are given in parentheses. The estimates and the standard errors are multiplied by 10^5. I calculate the standard errors under the null hypothesis that elasticity is 0 using the Delta method (Weisberg, 2005). Restriction R3 is dependent on individual couple characteristics, w_f and h_f, and cannot be tested globally. I present the standard errors and the p-values for R3 for the mean estimate. *, **, and *** represent rejection of the null hypothesis that elasticity is 0 at the 10-percent, 5-percent levels, and 1-percent levels, respectively.

Chapter 2

A Collective Model of Residential Mobility and Migration Applied to U.S. Couples

2.1 Introduction

Most studies of family residential mobility and migration treat the family as a single decision-making unit. This approach, developed by Mincer (1978), is based on the idea that the family chooses to move if this decision maximizes the family well-being. The model of family decision making that treats the family as a single decision-making unit is referred to as the unitary model . In the unitary model the family makes decisions as if maximizing a family utility function subject to a family-level budget constraint.

Empirical studies show that the unitary model does not hold in the context of various family decisions (see Vermeulen 2002 for a survey) . Researchers study such decisions as labor supply of the husband and the wife(Lundberg, 1988), expenditure on children (Lundberg et al., 1997), expenditure on clothing (Hotchkiss, 2005), and food and health expenditures (Thomas, 1997). In this study I describe and estimate a collective model of family residential mobility that does not rely on the unitary framework. I test the income pooling hypothesis of the unitary model, or the assumption that the only the total income of the family, and not the contributions by the family members, affects the family decision. My results are inconsistent with the unitary model, and support the role of intrahousehold bargaining in family decisions about relocation and migration.

The collective model of household decision-making makes a single assumption that the outcomes of family decisions are Pareto-optimal (Chiappori, 1988). If Pareto-optimality is assumed, the family decisions can be viewed as maximizations of a family welfare function equal to the weighted sum of the utility functions of the individuals in the family. The weights of the family members in the family welfare function reflect their decision-making power or bargaining power. The weights can be influenced by incomes, prices, and distribution factors, or the variables that do not affect individual preferences or the budget constraint, but affect the family decision (Browning et al., 1994). I this paper I use the proportion of asset income earned by the wife couple to reflect the bargaining power of the wife.

Recent studies find that the different objectives and decision-making roles of the husbands and the wives in married and cohabiting couples affect the family's residential mobility. Costa and Kahn (2000) and Compton and Pollak (2007) study the preferences of educated dual-earner couples to migrate to large metropolitan areas. They present the colocation problem as the possible reason that dual-earner couples concentrate in metropolitan areas. In dual-earner families the wife's career plans play a greater role in location decisions than in households where the husband is the breadwinner. Dual-earner families tend to move to large metropolitan areas to provide job opportunities for both spouses. Costa and Kahn find support for the importance of the colocation problem, while Compton and Pollak do not. The colocation problem is consistent with the idea that earning wives have greater bargaining power in decision making, and promote migration to the areas where they have better career opportunities. However, it is also consistent with the unitary model, because a move that ensures the career advancement for both spouses is likely to maximize family well-being. A formal empirical test is needed to distinguish between the reasons for the residential choices of dual-earner couples.

Bielby and Bielby (1992) and Shihadeh (1991) argue that the households do not move in order to increase the total household income, but are motivated by traditional gender roles, such as a higher value assigned to the husband's career as opposed to the wife's career. Bielby and Bielby analyze the 1977 Quality of Employment Survey, and find that while the husband's potential losses from a move deter the family from moving, the wife's losses of income due to a move do not decrease the family's probability of moving. Shihadeh uses the 1987 sample of Canadian couples to show that the chances for the wives of being employed after migration depend not on their economic and demographic characteristics, but on the strength of the traditional gender roles in the family, reported in the survey. Jacobsen and Levin (2000) find, on the contrary, that the couples weight the expected wage gains of the husbands and the wives equally when deciding to migrate.

Several studies of family migration focus on the consequences of migration for family members. Mincer (1978) refers to the spouse incurring losses due to the move as a tied mover, and calls the spouse losing potential career opportunities because the family does not move a tied stayer. Blackburn (2010) analyzes the Panel Study of income dynamics from the early 1970s and the 1990s, and finds that in U.S. couples the wives appear to be on average tied movers. Swain and Garasky (2007) find that the husbands are more likely than the wives to be tied stayers. Quinn and Rubb (2011) use the data on couples in 1999 and 2001 from the Panel Study of Income Dynamics to show that family migration has a negative impact on the labor-force participation and earnings of the wives. Cooke and Bailey (1996) find that, after controlling for the selection of families into migrants, family migration increases the probability of employment among married women and does not affect the probability of employment of married men, based on the Public Use Microdata Sample of the 1980 U.S. census.

I study how the preferences of the family members and their respective decision-making power affect the family choices with respect to all residential moves, migration, and the distance of moving. An understanding of the determinants of family mobility can help understand and predict the outcomes of migration for families that move.

I describe the collective model of family geographic mobility and estimate it using the restricted-use geolocation data from the Panel Study of Income Dynamics for 1985-1992. The data provides the census tracts of residence of the families and allows me to differentiate between relocation and migration, and incorporate the distance of moving into the model of geographic mobility. In section 2, I describe the economic model of geographic mobility, specify the role of the distribution of bargaining power in the family decisions, and derive the expression for the distance of moving that incorporates intrahousehold bargaining. The predictions of the model are identified in section 2.5. Section 3 contains the empirical strategy. I describe the data and the construction of the variables that represent the decision of the family to relocate, to migrate, and to move over a certain distance, and the choice of the explanatory variables. Section 4 displays the results, and section 5 summarizes the paper and provides an extended discussion of the results.

The results are contained in section 4, and section 5 p.

I use the restricted geolocation data from the Panel Study of Income dynamics to construct a precise measure of the distance of moving. I develop an expression for the distance of moving for families that move based on the collective model of family mobility, describe the implications of the model, and estimate it. I find support for the presence of intrahousehold bargaining in family mobility, and reject the income pooling hypothesis of the unitary model under varying model specifications.

In this paper I develop a collective model of family residential mobility and migration. I estimate the model using the data on internal migration of families in the U.S. during 1985-1992 from the PSID. The families include a married couple or an unmarried couple living together for at least a year. I refer to the man in the couple as the husband and to the woman, as the wife. I obtain restricted PSID data with the census tracts of residence of the families and construct a precise measure of the distance of the move. I define the distance of the move as the distance between the census tracts of residence of the family in two consecutive years. I define relocation as a change in the census tract of residence and migration as a change in the county, metropolitan statistical area, or core-based statistical area of residence with a distance of move above 10 miles. I employ the proportion of asset income contributed by the wife as a distribution factor that reflects her relative bargaining power in the family. I find that the distribution of the decision-making power in the family affect whether the family moves or migrates, and the distance of their move.

2.2 The Economic Model of Family Geographic Mobility

2.2.1 The Family As a Decision-Making Unit

The approach to geographic mobility as an investment in human capital was introduced by Sjaastad (1962). In his model, migrants choose their location to maximize the discounted value of lifetime earnings net of the moving costs. Polachek and Horvath (1977) describe a more general model of investment in human capital over the life cycle. In their model, the migrants or migrant families maximize the discounted value of lifetime utility subject to the rate of investment in human capital and information, and wage and asset growth rates. In the model of Polachek and Horvath, the family maximizes the discounted value of family utility.

A similar approach is used by Mincer (1978). In his paper, the family moves if the total gain from moving for family members exceeds the total costs of moving. The location that maximizes the family's net gain from moving is usually not the same location that maximizes the husband's or the wife's net gain from moving. The family's choice of the location of residence often produces tied movers - spouses that would be better off staying, but moved; and tied stayers - spouses that would prefer to move, but stayed.

In this paper I allow for the preferences and net gains from moving for the husband and the wife in the couple to affect the family decision differently depending on the distribution of the bargaining power in the couple. I expand the models of Sjaastad and others by explicitly describes the role of the distance of moving in the family choice of residence, and provides a parametric expression for the decision to move as well as the distance of moving for the families that move in the context of the collective model.

2.2.2 A Collective Model of Family Migration

I consider the residential choices of married and cohabiting couples and their families. The couple includes two decision-makers, a man, referred to as the husband , and the woman, referred to as the wife.

The individual i maximizes the discounted value of his or her lifetime utility

$$V_i = U(X_{it}, \tau_{it})e^{-\rho_i t}dt, \tag{2.1}$$

where X$_i$ is the individual's consumption, τ_i is his or her leisure time, and ρ_i is the discount factor of the individual.

The collective model of family decision-making is based on an assumption that the resource allocations within the family are Pareto Optimal. Mas-Colell et al. (1995) demonstrate that in a family with Pareto optimal allocations the family decisions can be viewed as a maximization of a social welfare function

$$V = (1-\mu)V_h + \mu V_w, \tag{2.2}$$

subject to the family-level budget constraint, i.e., that the total spending of family members does not exceed their income.

The weights assigned to the utility functions of the husband and the wife $(1-\mu)$ and μ represent their respective bargaining power. The parameter μ may depend on the incomes of the husband and the wife, their earnings capacity, the prices the goods that they prefer, and the distribution factors, or the variables that do not affect the preferences or the family budget constraint (Browning et al., 1994). In this paper I use the proportion of asset income received by the wife as the distribution factor. When the total asset income of the couple is included in the family budget constraint, the proportion of asset income received by the wife does not affect the preferences of the spouses or the family budget constraint, but may affect the wife's weight in the family welfare function.

2.2.3 Residential Location Choice

At the time t the family chooses where it will live at the time *t+1*. It can either stay at its original location l_0 or move to another location l.[1] For the individual i, the utility gain or loss from the family's choice of residence at the location l at the time *t+1* is

$$V_{li} - V_{l0i} - C_{li}, \tag{2.3}$$

where V_{li} is the expected value of lifetime utility at the time *t+1* for the individual i if the family resides in a location l, and C_{li} is the cost of moving to the location l for the individual i.

The change in the family social welfare function (2.2) due to a move to a location l at the time

[1] This model describes stable couples, or couples that stays together during two consecutive periods. In such couples losses incurred by one of the members of the couple due to the family residential location choice do not exceed the benefits of staying in the couple.

t+1 is

$$F = (1-\mu)(V_{lh} - V_{l_0h} - C_{lh}) + \mu(V_{lw} - V_{l_0w} - C_{lw}), \tag{2.4}$$

where μ is the relative bargaining power of the wife.

The family's choice of the location of residence at the time *t+1* maximizes the function F, subject to the family budget constraint. F can also be viewed as the social welfare function of the family at the time *t+1* that explicitly incorporates the real cost of moving C and the opportunity cost V_{l_0i}.

To simplify the objective function (2.4), I define the family value and cost functions at a location l as the weighted sum of the values and costs for the husband and the wife:

$$V_l = (1-\mu)V_{lh} + \mu V_{lw},\, C_l = (1-\mu)C_{lh} + \mu C_{lw}. \tag{2.5}$$

The objective function of the family becomes

$$F = V_l - V_0 - C_l. \tag{2.6}$$

The family moves if there is such a location l for which the expected family value exceeds the real and the opportunity costs of moving, or $F > 0$. If there are several locations for which $F > 0$, the family moves to the location that leads to the highest F.

2.2.4 Distance of the Move and the Location Choice

I make an empirical assumption and a proposition about the the relationship between the distance of move and the family's choice of residential location.

Assumption (a). Let D be the distance between the location of origin l_0 and the destination location l. For each decision-maker i the cost of moving C_{li} is increasing in D.

The cost of moving consist of the physical and the psychic costs associated with moving. The physical costs of moving increase with the distance of the move. It is more expensive to transport possessions and to travel over longer distances. The psychic costs of moving are the costs associated with maintaining social connections with family, friends, or business acquaintances that remained at the location of origin. The larger the distance of the move, the more time and money it takes for the family members to travel to the location of their previous residence, and for the friends and relatives of the family staying at the location of origin to visit the family.[2] Assumption (a) implies that the cost of moving for the family C_l, defined in equation (2.5), is also increasing in D.

Proposition (b). Let the $l_{opt}(D)$ be a location within D miles of the family's origin that gives the family the highest value V_l of all locations within D miles of l_0. The family will either stay at l_0 or move to $l_{opt}(D)$ for some D at the time *t+1*.

Proof. Let l_1 be a location D_1 miles away from l_0, and $l_1 \neq l_{opt}(D_1)$. $l_{opt}(D_1) \neq l_1$ means that $V_{lopt(D1)} > V_{l1}$. V_{l0} is independent of the location chosen at the time *t+1*. Furthermore, since $l_{opt}(D1)$ is located within D_1 miles of l_0, by assumption (a), $C_{lopt} \leq C_{l1}$. The family objective function (2.6) at the location $l_{opt}(D1)$ is then greater than the family objective function at the location l_1, and l_1 does not maximize the family objective function.

I define $V_{opt}(D) \equiv V_{lopt(D)}$. By definition of the optimal location $l_{opt}(D)$, $V_{opt}(D)$ is nondecreasing in D. Using assumption (a) and proposition (b), I rewrite the family objective function (2.6) in terms of its dependence on D:

$$F(D) = V_{opt}(D) - V_0 - C_l(D), \tag{2.7}$$

where $V_{opt}(D)$ is nondecreasing in D, and $C_l(D)$ is increasing in D.

2.2.5 Parametric Expression for the Distance of Move

I specify the objective function (2.7) parametrically in terms of its dependence on the distance of the move, in order to illustrate the relationships between the distance of moving for families that move and the characteristics of the family and the locations. I allow for a quadratic relationship

[2]There are factors other than the distance of the move that may affect the time and the expense of traveling and transporting possessions, such as the presence of roads, and the proximity to airports. However, the assumption that the cost of moving for an individual is positively associated with the distance of the move holds in most cases.

between the family value of the optimal destination and the distance of the move. The quadratic form is sufficiently general to approximate the other functional forms of the dependence of V_{opt} on D. [3]

The family value of the optimal destination $V_{opt}(D)$ depends on the distance of the move D in the following way:

$$V_{opt}(D) = \alpha_1 X_{V1} D + \alpha_2 D^2 + \alpha_3 X_{V2}, \tag{2.8}$$

where X_{V1} is the set of characteristics of the family and the locations that affect the value of the destination for the family differently for different distances of the move. I assume that the effect of X_{V1} on the optimal value of the destination $V_{opt}(D)$ changes linearly with distance. X_{V2} includes the variables that affect the value of the destination independently of the distance of move.

In the Section 1.3, I show that V_{opt} is nondecreasing in D: $V'_{opt}(D) \geq 0$. The rate of increase of V_{opt} is decreasing in D: $V''_{opt}(D) \leq 0$. The probability that the family finds a new optimal location within an additional mile of distance from the origin decreases with the distance from the origin. If the family finds the optimal location within an additional mile of the origin, the increase in the family value at this location becomes smaller with distance as the value of the best alternative one or more miles closer to the origin increases. An extended explanation is provided in the footnote.[4] Given the parametric specification (2.8), $V''_{opt}(D) \leq 0$ implies that $\alpha_2 \leq 0$.

I assume that the family costs of moving are linearly related to the distance of the move. I propose that both the physical and the psychic costs of moving exhibit an approximately linear relationship with the distance of the move. The physical cost of moving consists of the cost of moving possessions and people. The cost of moving possessions, whether using a moving company

[3]The empirical model used for the estimation of the family residential mobility is a reduced form sample selection model that does not rely on the quadratic form of the family value function. The expressions derived in this section serve as guidelines for the choice of the variables in the empirical model.

[4]Assume, for simplicity, that opportunities are uniformly distributed over an area. The probability that the most valuable location is within an additional mile of the origin is equal to the area of search gained by increasing the distance from D to $D+1$ divided by the area of the circle of radius D. This probability is $\frac{\pi(D+1)^2 - \pi D^2}{\pi D^2}$, which is a decreasing function of the distance D.

or transporting the property by yourself, can be modeled as a fixed cost plus a linear function of the distance, because the cost of gasoline is approximately linear in the distance of travel. The cost of travel by car consists of a fixed cost, such as renting a car, and the cost of gasoline, which is linear in distance. Similarly, the cost of airfare tends to exhibit a linear relationship with the distance of travel (Cameron, 2012). The psychic cost of moving for the family is the cost of maintaining social connections with the people remaining at the destination of origin, and the cost of losing some of these connections. The cost of maintaining relationships mainly consists of the cost of visiting, which is approximately linear in distance. The psychic cost due to losing social connections is increasing with the distance of moving, because relationships are harder to maintain when people live further from each other. The degree to which relationships are hard to maintain is, again, related to the cost of visiting, which is linear in distance.

The parametric expression of the relationship between the family cost of moving C and the distance of moving D is

$$C(D) = \beta_1 X_{C1} D + \beta_2 X_{C2}, \tag{2.9}$$

where X_{C1} includes independent variables that affect the cost of moving differently for moves over different distances. For example, the presence of friends and relatives in the location of origin can create a psychic cost for families that move away that is greater for moves over longer distances. X_{C2} includes all other variables that affect the cost of moving independently of the distance of the move. Assumption (a) implies that the family costs of moving are nondecreasing in the distance of the move, or $C'(D) \geq 0$.

The family moves if its objective function $F = V_{opt}(D) - V_0 - C_l(D)$ is positive. The value of the original location for the family,V_0 , does not depend on the destination of the move. For the family that moves, the optimal location choice must then be such that

$$V'_{opt}(D) = C'(D), \tag{2.10}$$

The family gain achieved by moving to the best location available one mile further equals the additional cost due to moving a mile further. The value that the family places on their original location, V_0, only affects whether the family moves, not where it moves.

Using the parametric specifications (2.8) and (2.9), the optimality condition (2.10) becomes

$$\alpha_1 X_{V1} + 2\alpha_2 D = \beta_1 X_{C1}. \tag{2.11}$$

Solving for D, I have the following expression for the distance of the move:

$$D = -\frac{1}{2\alpha_2}(\alpha_1 X_{V1} - \beta_1 X_{C1}). \tag{2.12}$$

The marginal increase in the value of the destination with the distance is decreasing, or $\alpha_2 \leq 0$. Therefore, $-\frac{1}{2\alpha_2} > 0$. Equation (2.12) shows that the distance of the move is positively related to the variables that increase the value of the destination for the family, and negatively related to the variables that increase the family's cost of moving. Only the variables that affect the value of the destination and the cost of moving differently for different distances of moving enter into equation (2.12).

Intrahousehold Bargaining and Distance of Move

Equation (2.12) describes the relationship between the family characteristics and the distance of the move, but does not address the roles that the family members and the distribution of the decision-making power among them play in the relocation decision.

Let $V_{opti}(D)$ be the value for the spouse i of the optimal family destination D miles away from its origin, and $C_i(D)$ - i's cost of moving over D miles. The functional forms for $V_{opti}(D)$ and $C_i(D)$ are specified similarly to the functional forms for the family value and cost functions.

$$V_{opti}(D) = \alpha_{1i} X_{V1} D + \alpha_{2i} D^2 + \alpha_{3i} X_{V2}, \tag{2.13}$$

$$C_i(D) = \beta_{1i} X_{C1} D + \beta_{2i} X_{C2}. \tag{2.14}$$

The independent variables in equations (2.13, 2.14) are the same as in the family value and cost equations and the same for the husband and the wife. α_{1i} reflects the importance of the variables that increase the value of a destination for the individual i, for example, i's education. The characteristics of the other spouse appear in the i's value equation, because they affect the choice of the optimal destination for the family at a given distance from the origin, but their affect is expected to be smaller. Similarly, β_{1i} reflects the importance of the variables that increase the cost of moving for the individual i, such as the presence of i's relatives in the family's original location. I expect the curvatures of the value of the optimal family destination functions of the husband and the wife, α_{2h} and α_{2w}, to be mostly determined by the factors discussed in section 1.4 that cause α_2 to be negative, and not dependent on the individual spouses' characteristics.

From definition (2.5),

$$V_{opt}(D) = (1-\mu)V_{opth}(D) + \mu V_{optw}(D), \tag{2.15}$$

$$C(D) = (1-\mu)C_h(D) + \mu C_w(D). \tag{2.16}$$

Inputting parametric specifications (2.13)- (2.14) into equations (2.15)-(2.16), I have the following expressions for the family value and cost functions

$$V_{opt}(D) = ((1-\mu)\alpha_{1h} + \mu\alpha_{1w})X_{V1}D + ((1-\mu)\alpha_{2h} + \mu\alpha_{2w})D^2 + ((1-\mu)\alpha_{3h} + \mu\alpha_{3w})X_{V2}, \tag{2.17}$$

$$C(D) = ((1-\mu)\beta_{1h} + \mu\beta_{1w})X_{C1}D + ((1-\mu)\beta_{2h} + \mu\beta_{2w})X_{C2}. \tag{2.18}$$

Comparing equations (2.17)–(2.18) to equations (2.8)–(2.9), I can see that the coefficients in the family value and cost functions are weighted sums of the coefficients in the individual's value and cost functions: $\alpha_1 = (1-\mu)\alpha_{1h} + \mu\alpha_{1w}$, $\alpha_2 = (1-\mu)\alpha_{2h} + \mu\alpha_{2w}$, and $\beta_1 = (1-\mu)\beta_{1h} + \mu\beta_{1w}$. The parametric expression for the distance of move that incorporates the coefficients from the individual spouses' value and cost functions and the distribution of bargaining power among the spouses is

$$D = \frac{((1-\mu)\alpha_{1h} + \mu\alpha_{1w})X_{V1} - ((1-\mu)\beta_{1h} + \mu\beta_{1w})X_{C1}}{-2((1-\mu)\alpha_{2h} + \mu\alpha_{2w})}. \tag{2.19}$$

If the wife's bargaining power μ increases, the denominator of the equation (2.19) is not expected to change substantially, because α_{2h} and α_{2w} are close.[5]

The term α_2 is negative, and, therefore, the denominator in equation (2.19) is positive. When the wife's bargaining power μ is high, the variables that increase the value of the destination for the wife, such as her education or work experience, increase the family's distance of moving more than the variables that increase the value of the destination for her husband. Conversely, the factors that increase the cost of moving for the wife, such as her attachment to the home location, deter the family from long-distance moves more than the factors that increase the cost of moving for the husband.

2.2.6 Model Predictions

The decision of the family whether to move or not empirically depends on the variables that affect the values of the origin and destination for the spouses, the costs of moving for the spouses, and the distribution of the decision-making power within the couple. Expression (2.19) implies that the distance of move for the families that move depends on a more narrow set of variables. The distance of move equation includes three sets of independent variables, variables that increase the value of the destination for the husband or the wife X_{V1}, variables that increase the cost of moving for the spouses X_{C1}, and variables that increase the relative bargaining power of the wife μ. X_{V1} and X_{C1} only include the variables that affect the values and costs for the family differently for different distances of the move. Equation (2.19) shows that X_{V1} increase the distance of the move, and X_{C1} decrease the distance of the move.

Conditional on the move, the variables related to the value of the location of origin and the

[5]See the third paragraph of this section.

factors that do not change with the distance of the move do not affect the distance of the move. This prediction is valid for the model of geographic mobility of individuals and of families acting as a single decision-making unit.

The feature of the model peculiar to the collective model is that the distribution of the bargaining power within the family has a predictable effect on the probability of moving and distance of the move. Equation (4) shows the role of the distribution of bargaining power in the couple in the family's decision to move, and equation (2.19) is a parametric expression for the distance of moving for families that move that includes the wife's relative bargaining power.

A higher value of the wife's bargaining power μ increases the positive effect that the variables increasing the value of the destination for her have on the probability of moving or the distance of moving. A higher μ increases the negative effect that the variables associated with a higher cost of moving for her have on the probability of moving or the distance of move. As an extreme example, if the wife has no bargaining power, only the variables that affect the value of the destination and the cost of moving for the husband affect the family mobility decisions.

In the empirical analysis I include the husband's education interacted with the proportion of the couple's asset income coming from the wife. The proportion of asset income contributed by the wife is a distribution factor that reflects the wife's bargaining power. I expect the husband's education to have a significant effect on the family relocation and migration, and to affect the value of the destination differently for the husband and the wife. In families in which the wife has more bargaining power, the husband's education is less important in the family mobility decisions. Therefore, I expect the coefficient on the husband's education interacted with the wife's proportion of asset income to have an opposite sign from the coefficient on the husband's education in the decision to move and distance of move estimation.

2.3 Empirical Strategy

I estimate the family residential mobility decisions using the 1985–1992 sample from the Panel Study of Income Dynamics (PSID) linked with the restricted geographic location data from the

PSID. The families consist of married couples and couples living together for at least a year.

I look at family relocation and the distance of moving for families that relocate, and migration and the distance of moving for migrants. I define relocation as a change in the census tract of residence between two consecutive interviews, and migration as relocation with the distance of moving above 10 miles and a change in the county, metropolitan statistical area, or core-based statistical area of residence. The distance of moving is the distance between the census tracts of residence of the family that moves.

I employ the two-step Heckman selection model to account for the selection of families into the families that relocate and migrate (Heckman, 1979).

In the first step, I estimate the decision to move using the probit binary choice model. In the second step, I estimate the distance of moving regression using the sample of families that move. The sample of families that relocate or migrate is likely to be different from the full sample in characteristics that also affect the distance of moving for families that move. This difference introduces a sample selection bias into the distance of move estimation. I include the sample selection correction term, the inverse Mills ratio, in the distance of move regression. The inverse Mills ratio is calculated using the estimates from the first stage probit regression, and can be interpreted as the conditional mean of the unobservable characteristics of the families that move.

The sample selection model is identified if there are variables in the decision to move probit that are excluded from the distance of move estimation. To identify the sample selection model for the decision to move, I include the characteristics of the census tract of residence of the couple prior to the decision to move in the selection probit, and exclude them from the distance of move regression. The characteristics of the location of origin that do not affect the attractiveness of the destination for the family do not affect the distance of moving.

The distribution of the decision-making power in the couple is reflected by the proportion of asset income contributed by the wife p. The decision to move probit and the distance of move regressions include the variable p and p interacted with the years of education of the husband. The husband's education is one of the most powerful predictors of relocation and migration and is a variable that is likely to affect the attractiveness of a given destination differently for the husband

and the wife. [6]

I do not restrict the sample based on the ages of the members of the couple. This study is concerned with the role of intrahousehold bargaining in relocation and migration. The distribution of bargaining power in the couple can affect working-age couples that move for job-related reasons, young couples, or retired couples. In the final section of the results, I report the results for the sample of families with the age of the husband between 25 and 54. This sample is likely to exclude the families that move in order to start an education program or due to retirement. The results are similar for the full sample and for the restricted-age sample.

The data includes families that appear in two consecutive interviews during 1985–1991. One family may appear in the sample multiple times, and appears 5 times on average. I compute the standard errors for all regressions using bootstrap to correct for the possible biases due to the nonindependence of observations and due to the error introduced by including the estimated term inverse Mills ration into the distance of move regression. The bootstrap method is a pairs bootstrap, outlined in Cameron and Trivedi (2005). A bootstrap sample is created by drawing with replacement from the set of individual families, and using all observations for each family that is drawn. The standard errors for all regressions are based on 5000 bootstrap samples.

In section 3.1, I describe the data and the construction of the distance of move variable, section 3.2 discusses the choice of the independent variables in the model, and section 4 present the results. I find evidence for the importance of the distribution of bargaining power in the couple on relocation and migration of families.

2.3.1 Data

The Panel Study of Income Dynamics is a longitudinal survey of a representative sample of American individuals and families, with the original sample including 4,800 families. All individuals from the original families are followed as they move or form new family units. An observation unit is a

[6] I find that the education of the wife has less predictive power that the husband's education in the family decision to move, and does not affect the decision to migrate and the distance of moving for families that relocate and migrate significantly.

married couple living together or an unmarried couple living together for at least a year. I refer to the man in the couple as the husband and to the woman, as the wife. [7]

My sample includes couples that were interviewed in two consecutive years, and can make a decision to relocate or migrate in the period between the two interviews. The PSID recorded forty one thousand interviews of married or cohabiting couples over the 1985-1992 period. I create a sample of twenty nine thousand observations of couples that appear in two consecutive yearly interviews.

The PSID pubic-use data releases the state of residence of the families and allows restricted access to precise geographic location data. The PSID restricted geographic data consist of the 1980, 1990, 2000, and 2010 geocoding files. I use the 2010 Geocode file, because it provides the most matches of interview numbers with the geographic areas. Less than one percent of the interview numbers could not be matched with the geographic areas.

The 2010 Geocode file contains the state, county, metropolitan statistical area (MSA), core based statistical area (CBSA), census tract, zip code, and incorporated or census designated place associated with the address of residence of each family interviewed by the PSID until 2011. The PSID keeps the addresses of PSID respondents confidential. The geocoding, or the process of assigning the state, county and other geographic areas to the addresses of the respondents, is based on the geographic regions, as defined by the Census Bureau in the 2010.

I compare the family's geographic location of residence in two consecutive interview years to determine if the family moved out of its census tract, zip code, county or other area during the period between the interviews. [8]Table 1 displays the numbers of families that changed a geographic area of residence between two consecutive interviews. Twelve percent of families changed their census tract, ten percent changed their zip code, five percent changed their county, and two percent changed their state of residence. The last row of Table 1 displays the variable that is equal to one if the family moved since the spring of the year prior to the interview. Seventeen percent of couples

[7]This analysis does not consider homosexual couples due to data limitations.

[8]The data does not allow me to determine if the family changed its location of residence multiple times between the interviews.

changed their residence since the spring of the previous year. Therefore, between a quarter and a third of residential moves were moves within a census tract. [9]

I define the distance of moving based on the family's census tracts of residence in two consecutive interviews. I match the census tract of the family in the PSID data with the census tracts in the 2010 census gazetteer file (United States Census Bureau, 2010) in order to obtain the latitude and the longitude of the internal point of each census tract. An internal point is a point within the census tract that corresponds to its approximate geographic center. The distance of the move for the family that moves is the distance between the internal points of the census tracts of the family's origin and destination, calculated using the Haversine formula for great-circle distances (Sinnott, 1984).

Figures 1 and 2 show the distribution of the distance of moving for the families that move. Figure 1 is the histogram of the distance of moving, and Figure 2 is the histogram of the log of the distance. The distance of moving is skewed right, with most moves occurring within 10 miles. The log of the distance of moving has two modes, one at 5 miles, and the other at 585 miles. The presence of two modes suggests that there may be district processes governing the local and long-distance moves.

Table 2 contains the number of families that move by the distance categories. Moves are concentrated in the low distance categories. One fifth of all moves are over the distance of 2.5 miles or less. Fifty seven percent of moves occur within 10 miles.

Table 3 shows the relationship between the distance of move and the reasons for moving. The families that moved since the spring of the previous year report a reason for moving. The respondents choose among eight reasons for moving. I combine the reasons into three groups: production reasons, such as moving in order to start a new job, or move closer to work; consumption reasons, such as moving in order to get a bigger or a smaller house, or to live in a better neighborhood; and

[9] The variable whether the family moved since the spring of the previous year is not directly comparable to the measures of geographic mobility based on the locations of the family at the times of the interviews. Most PSID interviews were conducted in the spring months, but a third of interviews was conducted during other seasons. The families that moved since the spring of the previous year may not have changed their address between the two consecutive interviews. Conversely, the families that were interviewed in winter and moved before spring have changed their address between the two consecutive interviews but not have moved since spring.

other reasons. I choose a sample of two thousand five hundred couples that changed their census tract of residence between two interviews and moved since the the spring of the previous year. [10]Most short-distance moves happen for reasons related to housing. Job related moves constitute only five percent of moves over distances under 5 miles. For moves over greater distances, production reasons and neighborhood related reasons become more important. In moves over 20 miles or greater, job-related reasons becomes the greatest reason category. Neighborhood-related reasons, and involuntary reasons, such as health reasons or divorce, become more important in moves over greater distances. Housing-related reasons, on the other hand, constitute a lower percentage of reported reasons for move for moves over greater distances.

2.3.2 Variables of the Model

Table 4 describes the variables included in the decisions to relocate and migrate and the distance of move regressions. Table 5 displays the summary statistics for the variables in the model, and Table 6 provides the summary statistics by families that change their census tract of residence and do not. The dependent variables are whether the family changed its census tract of residence, whether the family migrated, and the distance of moving. Thomlinson (1961) defines migration as a move that involves crossing a political boundary. I follow this definition by defining migration as a move into a different county, metropolitan statistical area, or core-based statistical area. In addition, I take advantage of the knowledge of the distance of moving and limit migration to moves over 10 miles.

Twelve percent of families change their census tract of residence in two consecutive years, and four percent migrate. The average distance of moving is 20 miles for the whole sample, and 167 miles for the families that relocate.

The independent variables consist of the characteristics of the couple, family composition, measures of the distribution of bargaining power in the family, and the characteristics of the family's location in the period before the decision to move. The couple's characteristics are the ages and

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[10]Of the couples that changed their census tract, 75 percent moved since the spring of the previous year.

the years of schooling of the spouses, the husband's race, the husband's health, and the indicator whether the husband's parents grew up in the same state [11]. I do not include the wife's health and race, because these characteristics of the spouses are highly correlated. The husband's and the wife's years of education are also correlated. I find that when the husband's education is included in the estimation, the education of the wife does not affect the probability of migrating and the distance of moving for families that relocate and migrate. The wife's education is included in the results reported in Tables 7–8, and excluded in the following tables.

The variables that reflect the family composition are the numbers of children ages 3 to 5, number of children ages 6 to 17, and whether people unrelated to the husband live in the household. I do not include the number of children under age 3 as an explanatory variable, because the decision to have children may be related to the decision to stay in an area. Similarly, I do not include the variables related to house ownership, because the decision to buy a house is likely related to the decision to stay in a location.

I include the variables asset income for the couple and the proportion of asset income coming from the wife to describe the distribution of bargaining power within the family. Asset income includes rent income, interest, dividends and alimony received by the husband or the wife. The wife's proportion of asset income is the ratio of the wife's asset income to the couple's asset income. The wife's proportion of the asset income p is a distribution factor. When the model includes asset income, the wife's contribution to the asset income does not affect the preferences of the spouses, the values of the locations of origin or destination for the spouses, or the cost of moving. Fifty eight percent of couples do not receive asset income. For these couples the wife's proportion of asset income is set to 0.5 to reflect a priori equal distribution of bargaining power. In Tables 15–18, I present the estimated results with an indicator whether the family receives asset income. I include this variable in order to allow for the families without asset income to exhibit different residential location choices. When I include the variable whether the family receives asset income, the distribution factor the wife's proportion of asset income and its interaction with the husband's

[11] The indicator whether the parents grew up in the same state is not available for the wife.

education affect the distance of moving but not the probability of moving.

The characteristics of the location of the family prior to the decision to move include the state unemployment, the size of the metro area, the natural amenities of the county, including the temperature, amount of sunlight, humidity, and land surface, the county per capita income, and the characteristics of the census tract of residence. I construct the characteristics of the census tract of residence from the sample of the PSID that includes non-couple households, and households that did not appear in two consecutive years. The characteristics of the census tract of residence include the median wages of the heads of household, and the proportions of the heads of households and wives in couples that were unemployed. The characteristics of the census tract of residence are included in the estimation of the probability of relocation and migration and excluded from the distance of moving regressions.

Table 6 contains the the summary statistics for the variables of the model, reported separately for the families that change their census tract of residence and those that do not. The couples that move are younger with a smaller difference in the ages of the partners. The average family that moves has a husband who is less likely to be white, more likely to be healthy and has more years of schooling than the husband in the family that does not move. Families that relocate live in a census tract with lower median wages and higher unemployment before the move than the families that stay. This is consistent with the importance of push factors in migration, or the characteristics of the location that induce people to leave.

2.4 Estimation Results

I estimate the family decisions to relocate and migrate and the distance of moving for families that relocate and migrants. Tables 7 and 8 present the results for the relocation decision and the distance of moving for families that relocate. These results include the education of the wife. I find that the wife's years of education have a negative effect on the probability of moving, and no significant effect on the distance of moving or migration. I exclude this variable from the remaining analysis.

Tables 9 and 10 present the results for the decision to migrate and the distance of moving for migrants. Younger couples and white couples are more likely to relocate and migrate. The number of children in the family reduces its probability of relocating and migrating, and does not affect the distances of moving for families that relocate and migrate. I present the results without the numbers of children in the distance of move regressions. Families with healthier husbands do not differ in their probability of relocating and migrating, but move over longer distances.

The families with greater years of schooling of the husband have a greater probability of relocating and migrating, and, when they move, their distance of moving is greater. The estimate of the effect of the husband's education on the probability of moving and the distance of moving is higher for migration than for relocation, as may be expected. Couples in which the husband is more educated expect to benefit more from migration, and the expected benefit increases with the distance of moving.

Higher median wages by census tract decrease the probability of the family to move out of the tract, and higher unemployment rates increase the family's probability of moving. These results support the importance of push factors in migration.

I find support for the collective model of family decision-making with respect to relocation and migration. The wife's proportion of asset income affects the probabilities of relocating and migrating and the distance of moving under most specifications. The wife's proportion of asset income interacted with the husband's years of education affects the distance of moving for families that relocate and migrants, and the probability of moving if the sample is restricted to working-age couples (Table 11). The estimate on the interaction of the wife's proportion of asset income with the husband's education has the opposite sign from the sign on the estimate on the husband's education, as predicted by the model. When the wife has more bargaining power, the variable that affects the value of the destination for the husband has less weight in the family decisions.

The finding abut the role of the distribution of bargaining power in the family in relocation and migration is preserved when I limit the sample to working-age couples (Tables 11-14).

In Tables 15-18, I include a variable indicating whether the family receives asset income. This specification accounts for the possibility that the wife's proportion of asset income affects the choice variables because the families that receive asset income are different from the families that do not. This difference may not be fully captured by including the asset income of the couple. I find that when the indicator of receiving asset income is included, the wife's proportion of asset income and its interaction with the husband's education do not affect the probabilities of relocating and migrating, but affect the distances of moving for families that relocate and migrate.

Under the unitary model, only the total asset income of the couple, or the indicator of receiving asset income may affect the family decision. Therefore, my results are inconsistent with the unitary model.

2.5 Discussion of the Results

I describe a model of family residential choice that incorporates the Pareto weights of the husband and the wife in the family objective function. I specify the family objective function parametrically, and express the distance of moving as a function of the characteristics of the family, characteristics of the location of origin and the optimal destination in a given distance from the origin, and the distribution of decision-making power in the couple. According to the model, not all variables that affect the probability of moving for the family affect the distance of moving for families that move. The choice of the variables depends on whether they affect the benefits derived from the locations of origin and destination and the costs of moving for the spouses differently for different moving distances. For instance, the variables associated with the attractiveness of the location of origin for the husband and the wife affect the couple's probability of moving, but not the particular set of destinations that they are considering. In practice, the variables associated with the location of origin are also associated with the destinations close to it. In this study the natural amenities of the county of residence of the family before its decision to move, such as the average temperature in January by county, affect the probabilities of relocation and migration, as well as the distances of moving for families that move.

The empirical analysis in this paper is based on the restricted geographic location data from the Panel Study of Income Dynamics. These data allow me to test the implications of the model of family residential choice. I find that the median wages and unemployment rates in the census tract of the family's original location affect the probabilities of relocating and migrating significantly, but do not affect on the distance of moving for families that move. I can then exclude these variables from the estimation of the distance of moving for the families that move in order to identify the sample selection model of the distance of move for families that relocate and migrate.

The precise geographic location data is important in distinguishing migration from geographic mobility. Researchers of migration often define migration as a crossing of a political boundary (Thomlinson, 1961). I define the distance of moving as the distance between the internal points of the census tracts of residence, and limit migration to moves across counties, metropolitan statistical areas and core-based statistical areas that have the distance of moving above 10 miles.

The ages of the spouses and the education of the husband have a similar effect on the family relocation and migration decisions. Younger couples are more likely to relocate and migrate, and couples with a more educated husband are more likely to relocate and migrate, and move further. The education of the wife reduces the probability of the family to relocate, but does not affect its probability of migrating or the distance of moving. This result suggests that in the sample of U.S. couples during 1985–1991 the earnings capacity of the wife did not play an important role in the residential choices of families, in particular, family migration decisions, after accounting for the earnings capacity of the husband.

Families that live in metropolitan areas are more likely to relocate, and tend to relocate over shorter distances. On the other hand, these families are less likely to migrate, and, when they do migrate, they move over longer distances than migrants from non-metropolitan areas. The numbers of preschool-age and school-age children in the family reduce the probabilities of relocating and migrating, but do not affect the distance of moving. Then, the costs of moving due to the number of children in the family do not vary significantly with the distance of moving. The benefits that can be derived from the move due to the change in the labor market opportunities for the parents, in particular, the husband, are not affected by the presence of children. I present the results without the numbers of children in the distance of move estimations.

The sample selection term the inverse Mills ratio does not affect the distance of moving for families that relocate or migrate. This means that the characteristics of the spouses, in particular, the husband's education, and the characteristics of the location of origin included in the model capture the difference between the samples of movers and stayers that affects the distance of moving.

I find evidence for the importance of intrahousehold bargaining in relocation and migration. When the total asset income of the couple and the binary variable indicating whether the family received asset income are included in the estimation, the wife's proportion of asset income p does not affect the probability of moving, but affects the distance of moving for families that relocate and migrate . In families with greater p, interpreted as the bargaining power of the wife, the education of the husband has a smaller positive effect on the distance of moving. If the wife receives all of the asset income in the couple the husband's education does not increase the distance of moving for the family. In this paper the education of the husband is a variable that represents the earnings capacity of the husband. According to my results, in families with greater bargaining power of the wife the earnings potential of the husband has a smaller effect on the choice of the residential location for families that relocate and migrate.

The government policies that increase the bargaining power of women in families, such as paid maternity leave, would reduce the dominant role that the husbands' earnings potential has on the family's choice of residential location. Such policies would reduce the number of wives that are tied movers, and increase the number of tied stayers among the husbands.

The results in this paper are inconsistent with the unitary model of family migration described by Mincer (1978), that proposes that the family migrates in order to maximize the family lifetime earnings. My results suggest that the families in which the husband has a lot of bargaining power place a high weight on the husband's education when choosing the destination of residence, even if the wife's current or potential earnings affect family income. In families with the wife possessing substantial bargaining power the education of the husband has a relatively small effect on the family's choice of residential location. This relationship holds even if the husband is the main earner in the family.

My estimates account for the education of the wife [12], which reflects the earnings capacity of the wife. The distribution factor the proportion of asset income received by the wife may be correlated with the relative earnings of the wife in a way that is not captured by including the education of the wife. The observed effect of the wife's proportion of asset income on family residential choices may then reflect the maximization family earnings. To address this possibility, future studies should estimate the collective model of residential mobility with a distribution factor unrelated to earnings, or include an instrumented measure of the earnings of the husband and the wife in the estimation.

[12] The wife's education does not appear significant in any estimations, except the probability of relocation, and is excluded.

2.6 Tables and Figures

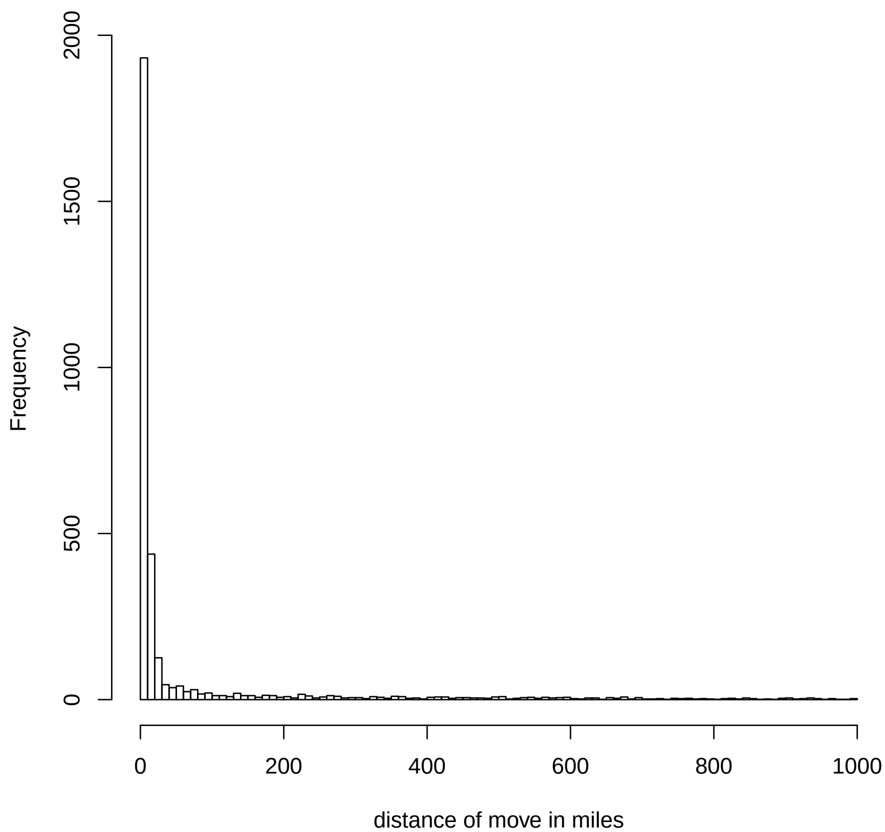
Table 2.1: Summary Statistics for the Variables Reflecting Geographic Mobility of Families.

	0	1	Percent With 1	Not Available	Percent Not Available
Changed state between two interviews	27 883	648	2.3	0	0.0
Changed county between two interviews	27 167	1356	4.8	8	0.0
Changed MSA[1] between two interviews	21 337	622	2.8	6572	23.0
Changed CBSA[1] between two interviews	25 373	836	3.2	2322	8.1
Changed census tract between two interviews	25 096	3408	12.0	27	0.1
Changed zip code between two interviews	25 770	2761	9.7	0	0.0
Changed place[1] between two interviews	20 699	1620	7.3	6212	21.8
Moved since the spring of previous year	24 450	4050	16.6	31	0.1

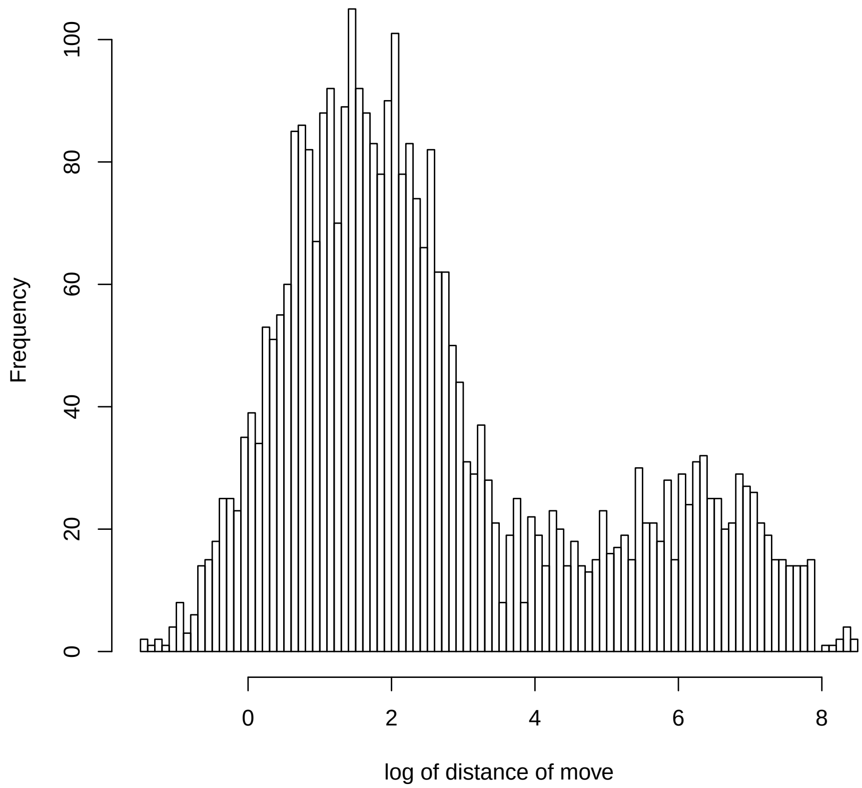
Notes: The sample consists of 28,531 couples that appear in two consecutive yearly interviews during 1985–1992. A couple changed its location of residence, such as state, county, etc., if its location of residence was different interviewed in year t changed its location of residence, such as state, county, etc., if its location in the t interview was different from its state in the $t{+}1$ interview. A couple moved in year t if it replied that it "moved since the Spring of the previous year" in the $t{+}1$ interview.

[1] MSA is a metropolitan statistical area, CBSA is a core base statistical area, and place is an incorporated or Census designated place. The geographic data were coded from the addresses of the families using the Census definitions of the geographic regions as of 2010 (United States Census Bureau, 2010).

Figure 2.1: Distance of Move for Movers based on Census Tract Information



This histogram includes 3209 moves under 1000 miles (95 percent of moves). The longest distance of move is 2626 miles. I exclude 16 observations of couples that moved out of Alaska and Hawaii, or with the distance of move above 3000 miles.



This histogram includes moves 3209 under 1000 miles (95 percent of moves). The first mode of the distribution occurs at 1.6, or 5 miles, and the second - at 6.4, or 585 miles.

Table 2.2: Number of Families that Move With Distance of Move Within a Certain Interval (In Miles)

Distance in Miles[1]	Number of Couples That Move	Percentage of Couples That Move
0-2.5 miles	741	21.9
2.5-5 miles	597	17.7
5-10 miles	594	17.6
10-20 miles	438	13.0
20-100 miles	339	10.0
100-200 miles	115	3.4
200-500 miles	207	6.1
500-1000 miles	178	5.3
1000-2000 miles	135	4.0
2000-3000 miles	38	1.1

Notes: The sample consists of 3382 couples that change their census tract of residence in two consecutive years. The sample excludes 16 observations of couples that move out of Hawaii or Alaska, or with the distance of move above 3000 miles.

[1] The distance intervals exclude the lower value and include the upper value.

Table 2.3: Proportion of Movers in Distance Categories That Move for Various Reasons

	Distance of Move in Miles							
Reasons for Move	0-5	5-10	10-20	20-100	100-500	500-1000	1000-2000	2000-5000
Production								
New job, stopped going to school, get nearer to work	5	9	17	37	53	41	46	31
Consumption								
Expansion of housing	35	28	23	13	4	4	2	0
Contraction of housing	9	10	9	3	3	4	4	5
Other house-related: want to own a home, got married	24	26	26	18	5	5	5	2
Neighborhood-related: neighborhood, schools	8	9	9	11	11	15	24	17
Other								
Outside events (involuntary): house destroyed, eviction, armed service, health, divorce	14	13	12	14	18	25	14	39
Mixed: save money, old neighbors moving away, retirement	7	5	5	4	5	7	4	5
Total observations in the distance interval	916	419	322	263	245	134	98	41

Notes: The sample consists of 2438 couples that change their census tract of residence between two interviews and move since the spring of the year prior to the second interview.

Table 2.4: Variable of the Model

	Variable Description
Geographic Mobility	
Changed tract	1 if the family changed census tract in two years
Migrated	1 if the family changed county or MSA of residence, and moved over the distance of at least 10 miles
	Distance between the internal points of the census tracts
Characteristics of the couple	
Husband's age	
Wife's age	
Husband is white	1 if the husband is white
Health of husband	A self-reported categorical variable, raging from 1 for poor health through 5 for excellent health
Husband's education	Husband's years of education, ranging from 1 to 17
Wife's education	Wife's years of education, ranging from 1 to 17
Husband's parents grew up in the same state	1 if the husband's parents grew up in the same state
Family composition	
Number of children ages 3 to 5	
Number of children ages 6 to 17	
Only relatives in the household	1 if the household contains only the relatives of the husband
Bargaining power	
Asset income	The husband's and the wife's yearly income from rent, interest, dividends, and alimony
Wife's proportion of asset income (p)	Proportion of asset income contributed by the wife[1]
State of origin characteristics	
State unemployment rate	Annual unemployment rate by state from the Bureau of Labor Statistics
County of origin characteristics	
County in large metro area	County in metro area of 1 million population or more
County in small metro area	County in metro area of less than 1 million population
Temperature in January	Mean temperature for January, 1941–1970
Sunlight in January	Mean hours of sunlight in January, 1941–1970
Humidity in July	Mean relative humidity in July, 1941–1970
Land surface	Topography code, ranging from 1 for flat plains to 21 for high mountains
County per capita income in 1980	Per capita income in 1979 by county from the National Historical Geographic Information System
Tract of origin characteristics	
Wages of heads of households	Median wages of the heads of households in the full PSID sample
Proportion of heads of household Unemployed	Proportion of the heads of household that were unemployed in the full PSID sample
Proportion of wives unemployed	Proportion of the wives in the full PSID sample that were unemployed

[1] In couples in which both members do not receive asset income the proportion of asset income coming from the wife's is 0.5. I assume that in these families the distribution of the bargaining power is equal. Fifty eight percent of couples do not receive asset income. In couples with asset income the wife's proportion of asset income is the ratio of her contribution to the family asset income to the family asset income.

Table 2.5: Descriptive Statistics

	min	25%	med	mean	sd	75%	max
Changed tract	0.00	0.00	0.00	0.12	0.32	0.00	1.00
Migrated	0.00	0.00	0.00	0.04	0.20	0.00	1.00
Distance of move	0.00	0.00	0.00	17.98	142.72	0.00	2626.06
Husband's age	17.00	32.00	39.00	42.61	14.49	52.00	97.00
Wife's age	16.00	29.00	36.00	39.86	13.79	48.00	89.00
Husband is white	0.00	0.00	1.00	0.73	0.44	1.00	1.00
Health of husband	1.00	3.00	4.00	3.68	1.10	5.00	5.00
Husband's education	0.00	12.00	12.00	12.40	3.14	14.00	17.00
Wife's education	0.00	12.00	12.00	12.40	2.73	14.00	17.00
Number of children ages 3–5	0.00	0.00	0.00	0.22	0.48	0.00	3.00
Number of children ages 6–17	0.00	0.00	0.00	0.77	1.04	1.00	8.00
Only relatives in the household	0.00	1.00	1.00	0.99	0.11	1.00	1.00
Asset income	0.00	0.00	0.00	2.14	11.31	0.60	600.00
Wife's proportion of asset income (p)	0.00	0.00	0.50	0.34	0.25	0.50	1.00
State unemployment rate	2.30	5.10	6.00	6.35	1.77	7.20	14.80
County in large metro area	0.00	0.00	0.00	0.48	0.50	1.00	1.00
County in small metro area	0.00	0.00	0.00	0.29	0.45	1.00	1.00
Temperature in January by county	−16.00	27.20	36.60	37.65	12.30	47.00	73.00
Sunlight in January by county	45.00	131.00	151.00	155.08	39.22	174.00	266.00
Humidity in July by county	14.00	58.00	63.00	60.53	13.07	68.00	80.00
Land surface by county	1.00	4.00	4.00	8.36	7.09	15.00	21.00
County per capita income in 1980	3.16	6.09	7.19	7.19	1.40	8.10	12.56
Wages of heads of household by tract	0.00	13.85	18.47	22.60	18.42	27.00	500.00
Unemployed heads of household by tract	0.00	0.00	0.02	0.05	0.08	0.07	1.00
Unemployed wives by tract	0.00	0.00	0.00	0.03	0.07	0.03	1.00

Notes: The sample consists of 27851 couples.
The asset income of the family, the county per capita income, and the median wages of the heads of the families by census tract are in 1000 dollars.

Table 2.6: Descriptive Statistics for Families that Change their Census Tract and Do Not Change their Census Tract

	min	25%	med	mean	sd	75%	max
Families that relocate							
Migrated	0.00	0.00	0.00	0.35	0.48	1.00	1.00
Distance of move	0.23	2.88	7.58	152.63	390.43	38.88	2626.06
Husband's age	18.00	27.00	32.00	35.15	11.91	39.00	90.00
Wife's age	16.00	25.00	30.00	32.67	11.20	37.00	87.00
Husband is white	0.00	0.00	1.00	0.71	0.45	1.00	1.00
Health of husband	1.00	3.00	4.00	3.87	1.05	5.00	5.00
Husband's education	0.00	12.00	12.00	12.78	2.85	15.00	17.00
Wife's education	0.00	12.00	12.00	12.60	2.52	14.00	17.00
Number of children ages 3–5	0.00	0.00	0.00	0.27	0.52	0.00	3.00
Number of children ages 6–17	0.00	0.00	0.00	0.65	1.00	1.00	6.00
Only relatives in the household	0.00	1.00	1.00	0.99	0.09	1.00	1.00
Asset income	0.00	0.00	0.00	1.17	5.62	0.10	89.60
Wife's proportion of asset income (p)	0.00	0.21	0.50	0.38	0.23	0.50	1.00
State unemployment rate	2.30	5.20	6.00	6.33	1.69	7.20	14.80
County in large metro area	0.00	0.00	1.00	0.53	0.50	1.00	1.00
County in small metro area	0.00	0.00	0.00	0.30	0.46	1.00	1.00
Temperature in January by county	6.70	28.60	39.60	39.08	12.31	47.50	73.00
Sunlight in January by county	45.00	132.00	152.00	157.50	39.57	175.25	266.00
Humidity in July by county	14.00	57.00	63.00	60.12	13.70	70.00	80.00
Land surface by county	1.00	2.00	4.00	8.01	7.01	15.00	21.00
County per capita income in 1980	3.92	6.37	7.33	7.35	1.35	8.23	12.56
Wages of heads of household by tract	0.00	13.00	17.50	20.39	13.55	25.00	275.00
Unemployed heads of household by tract	0.00	0.00	0.00	0.06	0.12	0.07	1.00
Unemployed wives by tract	0.00	0.00	0.00	0.04	0.11	0.03	1.00
Families that do not relocate							
Husband's age	17.00	32.00	40.00	43.60	14.51	54.00	97.00
Wife's age	16.00	30.00	37.00	40.82	13.82	50.00	89.00
Husband is white	0.00	0.00	1.00	0.74	0.44	1.00	1.00
Health of husband	1.00	3.00	4.00	3.65	1.10	5.00	5.00
Husband's education	0.00	12.00	12.00	12.35	3.18	14.00	17.00
Wife's education	0.00	12.00	12.00	12.37	2.76	14.00	17.00
Number of children ages 3–5	0.00	0.00	0.00	0.22	0.47	0.00	3.00
Number of children ages 6–17	0.00	0.00	0.00	0.78	1.05	1.00	8.00
Only relatives in the household	0.00	1.00	1.00	0.99	0.11	1.00	1.00
Asset income	0.00	0.00	0.00	2.27	11.86	0.75	600.00
Wife's proportion of asset income (p)	0.00	0.00	0.50	0.33	0.25	0.50	1.00
State unemployment rate	2.30	5.10	6.00	6.35	1.78	7.20	14.80
County in large metro area	0.00	0.00	0.00	0.48	0.50	1.00	1.00
County in small metro area	0.00	0.00	0.00	0.29	0.45	1.00	1.00
Temperature in January by county	−16.00	27.20	36.10	37.46	12.29	46.90	73.00
Sunlight in January by county	45.00	131.00	151.00	154.75	39.16	174.00	260.00
Humidity in July by county	14.00	58.00	63.00	60.58	12.98	68.00	80.00
Land surface by county	1.00	4.00	4.00	8.41	7.10	15.00	21.00
County per capita income in 1980	3.16	6.05	7.15	7.17	1.41	8.10	12.56
Wages of heads of household by tract	0.00	13.92	18.70	22.90	18.96	27.00	500.00
Unemployed heads of household by tract	0.00	0.00	0.03	0.05	0.07	0.07	1.00
Unemployed wives by tract	0.00	0.00	0.00	0.03	0.06	0.03	1.00

Notes: The sample consists of 27851 couples
House value, mortgage principal, and county median household income are in 1,000 dollars

2.6.1 Residential Mobility

Table 2.7: Decision to Move Probit. Dependent Variable is Whether the Family Changed Its Census Tract of Residence Between Two Yearly Interviews.

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−6.468	0.621	−10.409	0.000
Husband's age^2	0.061	0.006	10.275	0.000
Wife's age	−1.949	0.323	−6.042	0.000
Husband is white	7.423	3.219	2.306	0.021
Health of husband	0.073	1.292	0.056	0.955
Husband's education	3.776	0.965	3.912	0.000
Wife's proportion of asset income (p)	68.643	27.568	2.490	0.013
Wife's education	−1.523	0.700	−2.175	0.030
Husband's parents grew up in the same state	−5.613	2.925	−1.919	0.055
Number of children ages 3–5	−7.367	2.459	−2.996	0.003
Number of children ages 6–17	−4.694	1.351	−3.474	0.001
Only relatives in the household	11.183	11.631	0.961	0.336
Asset income	0.020	0.117	0.171	0.864
State unemployment rate	−2.101	0.724	−2.902	0.004
County in large metro area	12.051	4.240	2.842	0.004
County in small metro area	11.515	3.625	3.177	0.001
Temperature in January by county	0.785	0.139	5.664	0.000
Sunlight in January by county	−0.072	0.041	−1.760	0.078
Humidity in July by county	−0.410	0.110	−3.714	0.000
Land surface by county	−0.865	0.184	−4.697	0.000
County per capita income in 1980	5.603	1.126	4.978	0.000
Wages of heads of household by tract	−0.654	0.109	−6.002	0.000
Unemployed heads of household by tract	51.764	14.097	3.672	0.000
Unemployed wives by tract	42.827	13.870	3.088	0.002
Husband's education × p	−3.515	1.933	−1.819	0.069

Notes: The sample consists of 27439 couples. 3217 couples, or 12 percent change their census tract of residence in two consecutive years.
The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

Table 2.8: Distance of Move Estimation for Families that Change their Census Tract. Dependent Variable is The Distance of Move Between Census Tracts.

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−444.039	535.625	−0.829	0.407
Husband's age^2	6.802	5.688	1.196	0.232
Wife's age	208.683	185.558	1.125	0.261
Husband is white	4422.523	1606.722	2.753	0.006
Health of husband	2213.480	756.021	2.928	0.003
Husband's education	2462.612	646.522	3.809	0.000
Wife's proportion of asset income (p)	33 681.143	15 952.401	2.111	0.035
Wife's education	695.775	401.640	1.732	0.083
Husband's parents grew up in the same state	−1499.542	1829.955	−0.819	0.413
Only relatives in the household	9916.968	2377.449	4.171	0.000
Asset income	−15.837	188.595	−0.084	0.933
County in large metro area	−3458.658	2517.726	−1.374	0.170
County in small metro area	−1309.885	2281.500	−0.574	0.566
Temperature in January by county	89.271	90.215	0.990	0.322
Sunlight in January by county	18.324	30.606	0.599	0.549
Humidity in July by county	−68.379	71.168	−0.961	0.337
Land surface by county	355.487	140.868	2.524	0.012
County per capita income in 1980	576.455	779.909	0.739	0.460
Inverse Mills ratio	−5113.656	6576.853	−0.778	0.437
Husband's education × p	−2757.227	1198.717	−2.300	0.022

Notes: The sample consists of 3217 couples that change their census tract of residence.
The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

2.6.2 Migration

Table 2.9: Migration Participation Probit. Dependent Variable is Whether the Family Changed Its County or MSA of Residence With The Distance of Move Over 10 Miles.

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−5.183	0.869	−5.962	0.000
Husband's age^2	0.047	0.008	5.626	0.000
Wife's age	−0.944	0.436	−2.168	0.030
Husband is white	23.126	4.748	4.871	0.000
Health of husband	3.248	1.848	1.758	0.079
Husband's education	7.070	1.159	6.101	0.000
Wife's proportion of asset income (p)	75.945	36.658	2.072	0.038
Husband's parents grew up in the same state	−6.011	3.815	−1.576	0.115
Number of children ages 3–5	−8.048	3.330	−2.417	0.016
Number of children ages 6–17	−7.779	1.891	−4.113	0.000
Asset income	−0.107	0.182	−0.586	0.558
State unemployment rate	−1.344	0.983	−1.367	0.172
County in large metro area	−14.487	5.120	−2.830	0.005
County in small metro area	−9.166	4.337	−2.113	0.035
Temperature in January by county	0.306	0.178	1.716	0.086
Sunlight in January by county	0.035	0.052	0.666	0.506
Humidity in July by county	−0.153	0.143	−1.070	0.285
Land surface by county	−0.656	0.240	−2.735	0.006
County per capita income in 1980	4.206	1.457	2.887	0.004
Wages of heads of household by tract	−0.390	0.136	−2.862	0.004
Unemployed heads of household by tract	24.784	20.758	1.194	0.232
Unemployed wives by tract	43.107	18.840	2.288	0.022
Husband's education × p	−4.114	2.606	−1.578	0.114

Notes: The sample consists of 27865 couples. 1160 couples, or 4 percent move.
The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

Table 2.10: Distance of Move Estimation for Families that Migrate. Dependent Variable is The Distance of Move Between Census Tracts

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−1763.934	1370.321	−1.287	0.198
Husband's age^2	23.230	14.221	1.634	0.103
Wife's age	−76.344	420.059	−0.182	0.856
Husband is white	2156.061	6145.413	0.351	0.726
Health of husband	3460.163	1807.359	1.914	0.056
Husband's education	4075.017	1807.908	2.254	0.024
Wife's proportion of asset income (p)	81 436.327	40 386.922	2.016	0.044
Husband's parents grew up in the same state	−2647.658	4164.518	−0.636	0.525
Asset income	135.127	315.840	0.428	0.669
State unemployment rate	−1148.063	1056.412	−1.087	0.277
County in large metro area	11 200.983	5577.483	2.008	0.045
County in small metro area	11 993.157	4653.594	2.577	0.010
Temperature in January by county	593.894	221.555	2.681	0.007
Sunlight in January by county	−20.800	80.676	−0.258	0.797
Humidity in July by county	−421.663	180.558	−2.335	0.020
Land surface by county	869.685	339.809	2.559	0.011
County per capita income in 1980	1236.881	1716.003	0.721	0.471
Inverse Mills ratio	1034.079	19 720.916	0.052	0.958
Husband's education × p	−6030.795	2827.658	−2.133	0.033

Notes: The sample consists of 1160 couples that change their county or MSA of residence with the distance of move over 10 miles.

The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

2.6.3 Families With the Age of Husband Between 25 and 54

Residential Mobility

Table 2.11: Decision to Move Probit. Dependent Variable is Whether the Family Changed Its Census Tract of Residence Between Two Yearly Interviews.

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−9.433	2.032	−4.642	0.000
Husband's age^2	0.108	0.027	4.012	0.000
Wife's age	−2.408	0.415	−5.796	0.000
Husband is white	6.193	3.561	1.739	0.082
Health of husband	0.816	1.494	0.546	0.585
Husband's education	4.983	1.180	4.223	0.000
Wife's proportion of asset income (p)	111.158	36.927	3.010	0.003
Husband's parents grew up in the same state	−6.179	3.285	−1.881	0.060
Number of children ages 3–5	−5.749	2.591	−2.219	0.027
Number of children ages 6–17	−3.238	1.488	−2.175	0.030
Only relatives in the household	14.856	14.660	1.013	0.311
Asset income	−0.078	0.215	−0.363	0.717
State unemployment rate	−2.698	0.800	−3.374	0.001
County in large metro area	7.381	4.788	1.542	0.123
County in small metro area	7.882	4.250	1.855	0.064
Temperature in January by county	0.928	0.151	6.127	0.000
Sunlight in January by county	−0.072	0.047	−1.533	0.125
Humidity in July by county	−0.398	0.123	−3.236	0.001
Land surface by county	−1.085	0.209	−5.194	0.000
County per capita income in 1980	6.928	1.253	5.531	0.000
Wages of heads of household by tract	−0.695	0.122	−5.698	0.000
Unemployed heads of household by tract	63.459	15.201	4.175	0.000
Unemployed wives by tract	45.185	15.709	2.876	0.004
Husband's education × p	−5.964	2.608	−2.287	0.022

Notes: The sample consists of 20291 couples. 2560 couples, or 12.6 percent change their census tract of residence in two consecutive years.
The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

Table 2.12: Distance of Move Estimation for Families that Change their Census Tract. Dependent Variable is The Distance of Move Between Census Tracts.

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−1110.642	1119.359	−0.992	0.321
Husband's age^2	15.220	14.437	1.054	0.292
Wife's age	108.873	208.675	0.522	0.602
Husband is white	5352.342	1746.860	3.064	0.002
Health of husband	2035.597	776.946	2.620	0.009
Husband's education	3784.689	777.537	4.868	0.000
Wife's proportion of asset income (p)	58 233.599	21 374.557	2.724	0.006
Husband's parents grew up in the same state	−458.991	1864.460	−0.246	0.806
Only relatives in the household	10 786.855	2779.155	3.881	0.000
Asset income	−73.377	200.428	−0.366	0.714
County in large metro area	−4642.262	2842.372	−1.633	0.103
County in small metro area	−3207.986	2449.114	−1.310	0.190
Temperature in January by county	98.106	102.470	0.957	0.338
Sunlight in January by county	16.294	31.597	0.516	0.606
Humidity in July by county	−94.149	84.786	−1.110	0.267
Land surface by county	281.856	159.020	1.772	0.076
County per capita income in 1980	868.150	847.595	1.024	0.306
Inverse Mills ratio	−2388.646	5914.743	−0.404	0.686
Husband's education × p	−4382.702	1562.668	−2.805	0.005

Notes: The sample consists of 2560 couples that change their census tract of residence.
The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

Migration

Table 2.13: Migration Participation Probit. Dependent Variable is Whether the Family Changed Its County or MSA of Residence With The Distance of Move Over 10 Miles.

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−7.893	2.807	−2.812	0.005
Husband's age^2	0.088	0.037	2.369	0.018
Wife's age	−1.412	0.562	−2.511	0.012
Husband is white	22.291	5.607	3.975	0.000
Health of husband	4.169	2.129	1.958	0.050
Husband's education	9.457	1.534	6.167	0.000
Wife's proportion of asset income (p)	107.090	46.720	2.292	0.022
Husband's parents grew up in the same state	−5.658	4.476	−1.264	0.206
Number of children ages 3–5	−6.489	3.594	−1.806	0.071
Number of children ages 6–17	−5.865	2.236	−2.623	0.009
Asset income	−0.176	0.374	−0.471	0.637
State unemployment rate	−1.448	1.151	−1.258	0.208
County in large metro area	−22.050	5.983	−3.686	0.000
County in small metro area	−14.660	5.290	−2.771	0.006
Temperature in January by county	0.375	0.202	1.853	0.064
Sunlight in January by county	0.051	0.061	0.838	0.402
Humidity in July by county	−0.084	0.165	−0.511	0.610
Land surface by county	−0.907	0.283	−3.199	0.001
County per capita income in 1980	6.561	1.671	3.927	0.000
Wages of heads of household by tract	−0.443	0.157	−2.817	0.005
Unemployed heads of household by tract	25.635	22.852	1.122	0.262
Unemployed wives by tract	42.822	24.484	1.749	0.080
Husband's education × p	−5.691	3.216	−1.770	0.077

Notes: The sample consists of 20291 couples. 882 couples, or 4.4 percent move.
The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

Table 2.14: Distance of Move Estimation for Families that Migrate. Dependent Variable is The Distance of Move Between Census Tracts

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−2632.686	3042.974	−0.865	0.387
Husband's age^2	37.601	38.096	0.987	0.324
Wife's age	−142.525	495.113	−0.288	0.774
Husband is white	4895.052	6648.326	0.736	0.462
Health of husband	3442.644	2263.384	1.521	0.129
Husband's education	5031.373	2272.948	2.214	0.027
Wife's proportion of asset income (p)	99 453.694	54 538.446	1.824	0.069
Husband's parents grew up in the same state	−1133.259	4518.807	−0.251	0.802
Asset income	−129.797	367.914	−0.353	0.724
County in large metro area	8745.778	6895.901	1.268	0.205
County in small metro area	7454.642	5856.250	1.273	0.203
Temperature in January by county	582.907	232.650	2.506	0.012
Sunlight in January by county	−6.922	79.237	−0.087	0.930
Humidity in July by county	−456.324	202.771	−2.250	0.025
Land surface by county	825.306	397.277	2.077	0.038
County per capita income in 1980	855.256	2005.048	0.427	0.670
Inverse Mills ratio	−1619.255	19 479.861	−0.083	0.934
Husband's education × p	−7511.960	3744.886	−2.006	0.045

Notes: The sample consists of 882 couples that change their county or MSA of residence with the distance of move over 10 miles.

The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

2.6.4 Model Includes The Binary Variable For The Couple Receiving Asset Income

Residential Mobility

Table 2.15: Decision to Move Probit. Dependent Variable is Whether the Family Changed Its Census Tract of Residence Between Two Yearly Interviews.

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−6.437	0.608	−10.583	0.000
Husband's age^2	0.061	0.006	10.211	0.000
Wife's age	−1.922	0.312	−6.162	0.000
Husband is white	9.026	3.150	2.865	0.004
Health of husband	0.172	1.279	0.134	0.893
Husband's education	3.165	0.911	3.473	0.001
Wife's proportion of asset income (p)	46.604	28.459	1.638	0.102
Husband's parents grew up in the same state	−5.385	2.816	−1.912	0.056
Number of children ages 3–5	−7.765	2.467	−3.147	0.002
Number of children ages 6–17	−4.725	1.308	−3.613	0.000
Only relatives in the household	10.702	11.472	0.933	0.351
Asset income	0.042	0.114	0.367	0.714
Receive asset income	−12.908	3.889	−3.319	0.001
State unemployment rate	−2.333	0.717	−3.253	0.001
County in large metro area	11.990	4.160	2.883	0.004
County in small metro area	11.368	3.698	3.074	0.002
Temperature in January by county	0.805	0.138	5.834	0.000
Sunlight in January by county	−0.077	0.041	−1.881	0.060
Humidity in July by county	−0.417	0.107	−3.897	0.000
Land surface by county	−0.828	0.182	−4.539	0.000
County per capita income in 1980	5.740	1.082	5.307	0.000
Wages of heads of household by tract	−0.661	0.107	−6.204	0.000
Unemployed heads of household by tract	55.254	13.947	3.962	0.000
Unemployed wives by tract	45.847	13.542	3.386	0.001
Husband's education × p	−2.836	2.020	−1.404	0.160

Notes: The sample consists of 27439 couples. 3217 couples, or 12 percent change their census tract of residence in two consecutive years.
The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

Table 2.16: Distance of Move Estimation for Families that Change their Census Tract. Dependent Variable is The Distance of Move Between Census Tracts.

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−610.690	507.296	−1.204	0.229
Husband's age^2	8.069	5.427	1.487	0.137
Wife's age	219.409	180.794	1.214	0.225
Husband is white	4272.166	1584.934	2.695	0.007
Health of husband	2250.008	720.768	3.122	0.002
Husband's education	2884.681	612.471	4.710	0.000
Wife's proportion of asset income (p)	41 735.257	16 151.314	2.584	0.010
Husband's parents grew up in the same state	−1699.832	1807.379	−0.940	0.347
Only relatives in the household	10 651.880	2209.435	4.821	0.000
Asset income	−19.669	193.089	−0.102	0.919
Receive asset income	1692.201	2496.296	0.678	0.498
County in large metro area	−2651.759	2508.172	−1.057	0.290
County in small metro area	−781.541	2291.658	−0.341	0.733
Temperature in January by county	72.620	87.873	0.826	0.409
Sunlight in January by county	16.710	29.786	0.561	0.575
Humidity in July by county	−72.523	71.435	−1.015	0.310
Land surface by county	329.386	137.185	2.401	0.016
County per capita income in 1980	546.557	777.694	0.703	0.482
Inverse Mills ratio	−3827.494	6223.432	−0.615	0.539
Husband's education × p	−3200.363	1183.517	−2.704	0.007

Notes: The sample consists of 3217 couples that change their census tract of residence.
The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

Migration

Table 2.17: Migration Participation Probit. Dependent Variable is Whether the Family Changed Its County or MSA of Residence With The Distance of Move Over 10 Miles.

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−5.137	0.873	−5.882	0.000
Husband's age^2	0.047	0.008	5.578	0.000
Wife's age	−0.884	0.436	−2.028	0.043
Husband is white	24.580	4.707	5.222	0.000
Health of husband	3.466	1.832	1.892	0.058
Husband's education	7.233	1.239	5.838	0.000
Wife's proportion of asset income (p)	51.125	40.583	1.260	0.208
Husband's parents grew up in the same state	−6.267	3.857	−1.625	0.104
Number of children ages 3–5	−8.354	3.414	−2.447	0.014
Number of children ages 6–17	−8.183	1.967	−4.160	0.000
Asset income	−0.056	0.161	−0.348	0.728
Receive asset income	−14.617	5.077	−2.879	0.004
State unemployment rate	−1.399	0.994	−1.407	0.160
County in large metro area	−14.134	5.040	−2.804	0.005
County in small metro area	−8.874	4.508	−1.969	0.049
Temperature in January by county	0.297	0.173	1.713	0.087
Sunlight in January by county	0.033	0.051	0.645	0.519
Humidity in July by county	−0.153	0.138	−1.103	0.270
Land surface by county	−0.635	0.241	−2.633	0.008
County per capita income in 1980	4.221	1.454	2.903	0.004
Wages of heads of household by tract	−0.376	0.134	−2.802	0.005
Unemployed heads of household by tract	23.700	21.078	1.124	0.261
Unemployed wives by tract	42.962	18.739	2.293	0.022
Husband's education × p	−3.687	2.800	−1.317	0.188

Notes: The sample consists of 27865 couples. 1160 couples, or 4 percent move.
The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

Table 2.18: Distance of Move Estimation for Families that Migrate. Dependent Variable is The Distance of Move Between Census Tracts

	Estimate*100	Std. Error*100	t-value	Pr(>|t|)
Husband's age	−1658.113	1286.461	−1.289	0.198
Husband's age^2	22.092	13.331	1.657	0.098
Wife's age	−78.236	408.426	−0.192	0.848
Husband is white	805.972	5952.624	0.135	0.892
Health of husband	3371.998	1810.902	1.862	0.063
Husband's education	3849.969	1770.965	2.174	0.030
Wife's proportion of asset income (p)	90 550.066	39 822.442	2.274	0.023
Husband's parents grew up in the same state	−2539.065	4216.132	−0.602	0.547
Asset income	105.333	308.081	0.342	0.732
Receive asset income	6908.104	5838.730	1.183	0.237
County in large metro area	11 581.492	5694.297	2.034	0.042
County in small metro area	12 222.919	4912.061	2.488	0.013
Temperature in January by county	514.042	187.184	2.746	0.006
Sunlight in January by county	5.961	72.762	0.082	0.935
Humidity in July by county	−387.920	162.883	−2.382	0.017
Land surface by county	904.959	327.769	2.761	0.006
County per capita income in 1980	1216.724	1743.499	0.698	0.485
Inverse Mills ratio	−478.201	18 929.403	−0.025	0.980
Husband's education × p	−5994.141	2777.886	−2.158	0.031

Notes: The sample consists of 1160 couples that change their county or MSA of residence with the distance of move over 10 miles.
The standard errors are computed using bootstrap, with 5000 replications. I perform a pairs bootstrap to correct for the multiple appearance of the families in the sample over the 1985-1992 period.

Chapter 3

Time Series Analysis of the Decline in Marriage Rates in the U.S., 1960–2011

3.1 Introduction

After 1970 the marriage rate in the U.S. started to decline. By 2002 it reached the lowest point since 1920. Figure 1 illustrates the changes in labor force participation and median earnings of men and women, and in demographic rates since 1920. Labor force participation rates of men are falling and labor force participation rates of women are rising since 1948. Median earnings of women are steadily rising since 1960, while those of men are stagnant since 1973.

Social scientists examine the reasons for the decline in the marriage rate at the end of the 20th century. Some researchers believe that changes in the relative economic positions of men and women led to lower gains from marriage due to specialization. Others note that with changes in household technology and social norms, gender specialization played a decreasingly important role in marriage choice. In Section 2, I discuss the determinants of the decision to marry, and changes happening in the U.S. at the end of the 20th century that affected this decision. Section 3 includes the overview of empirical literature on the decline in marriage rates, and a review of time series studies of demographic processes.

I argue that time series analysis of aggregate data provides methodological advantages in studying changes in society over time. This study uses yearly data for the 1960–2011 period. The data consist of labor force participation rates of men and women, median earnings of men and women employed full-time and year-round, marriage rate, divorce rate, and birth rate. Section 4 describes the data. The following sections describe the time series properties of the data, fit models to the data, and examine the responses of the marriage rate to shocks in the variables based on the model of choice. The economic explanation for the decline in marriage rates is generally supported, with the increase in the median earnings of women having the most robust effect.

3.2 Determinants of Marriage

3.2.1 Economic Theory of Marriage

Gary Becker in *Theory of Marriage* (1973) describes the decision of couples to marry and the source of economic gains from marriage. In the economic theory of marriage, two people choose to marry if they expect to increase their utility by marriage. Michael and Becker (1973) describe a model of consumer behavior in which consumers derive utility not from goods and services purchased in the market but from commodities produced within a household. These commodities are produced using market goods and time of household members, and can not be bought or sold in the market. They include quality and quantity of children, quality of recreation, quality of meals, health, etc. Under general conditions, commodities produced by the household can be combined into a single commodity Z (Becker, 1973). Consumers seek to maximize the amount of commodity Z that they receive. Gains to marriage arise if the married couple can produce more Z than the total amount produced by the individuals if they remained single.[1]

Gains to marriage depend on complementarities of inputs in production of household commodities, where inputs include the spouses' time and market goods. Complementarities of inputs arise when inputs are not perfect substitutes of each other. Becker (1973) discusses the complementarity of the time of spouses and market goods in raising children. The greater the expected quantity and quality of children for the couple, the greater the expected gains from marriage through complementarity of inputs into child rearing.

Complementarity between the time of spouses is greater when they specialize in different activities. According to Becker, women, for biological and cultural reasons, are greater endowed with

[1]Becker does not discuss the distribution of resources within the family. He assumes that a couple will choose to marry if there are expected gains from marriage, even if one of the partners does not expect to receive more resources.

human capital that raises productivity in household production. Stanley and Jarrell (1998) perform a meta-regression analysis of gender wage discrimination in the U.S. during the 1959–1986 period and find a significant, although declining, wage gender gap throughout the period. If, on average, men have a competitive advantage in the market, men's specialization in market work, and women's specialization in household production lead to the greatest gains from marriage, according to Becker's theory.

In this paper I include four series that reflect the extent of gender specialization in the society. They are the labor force participation rates and the yearly earnings of men and women. [2]If Becker's economic theory of marriage holds, greater labor force participation rate of men is associated with higher gains from marriage on average, and greater labor force participation rate of women reflects lower gender specialization and consequently leads to lower average gains from marriage.

A more rapid rise in the women's earnings compared to those of men results from a greater rise in the women's hours of work than those of men, or a convergence of wage rates of men and women. Both of these processes reflect a decrease in gender specialization in society, and therefore, decrease gains from marriage. Becker's theory of marriage predicts that when male earnings rise at a greater rate than female earnings, average gains from marriage increase and more couples decide to marry.This study is based on the yearly time series data for 1960–2011. During the first 12 years, male earnings rose more rapidly than female earnings. During the remaining 38 years, male earnings stagnated, while female earnings continued to rise. Therefore, if Becker's theory holds, my data is likely to show the negative effect of female earnings on the marriage rate more strongly than the positive effect of male earnings on the marriage rate.

3.2.2 Alternative Economic Explanations of Marriage

Stevenson and Wolfers (2007) argue that marriage creates not only production complementarities but also consumption complementarities. Consumption complementarities follow from joint consumption of household public goods, such as the common time spent with children. Consumption

[2]The wage rates by gender are not available for a sufficiently long time series sample.

complementarities also arise when one's utility from consuming a good, for example a meal or leisure time, increases with his or her spouse's consumption of the same good.

The development of market and household technologies in the end of the 20th century increased wealth and leisure time, leading to greater gains from consumption complementarities (Stevenson and Wolfers, 2007). On the other hand, the importance of production complementarities declined. Improvements in household technology, such as dishwasher machines and washers and driers, made household work easier and less time consuming. Consequently, gains from investment in household specific human capital decreased. Furthermore, the goods and services that were previously produced mainly in the household, such as childcare, cooking, and cleaning, were increasingly delegated to the market.

Greenwood and Guner (2008) note that technological progress in market and household sectors not only decreased production complementarities in marriage but also freed the time for women to enter the labor force. Greater labor force participation of women may have, in turn, contributed to lower marriage rate through reduction in gains from gender specialization.

Higher life expectancy and lower fertility meant that lower proportion of time in marriage is spent living with children, reducing the importance of complementarities in child rearing and children in the life of adults.

3.2.3 Other Factors Affecting Marriages

Goldin and Katz (2000) find that the introduction of contraceptive technology in the 1960s played a key role in changing the labor force and family choices of women. The availability of contraceptive technology contributed to increased age at first marriage. This allowed people to invest in their career and education without loosing opportunities to find a marriage partner. With later age at first marriage, the time that women spend in the labor market increased, and investment in market related human capital became more profitable. On the other hand, time spent in marriage decreased, and returns to investment in household related human capital decreased. This led to lower gains from marriage.

Goldin (2006) uses the surveys of college freshmen in 1960s to show that young women expected to derive satisfaction from their career. Goldin argues that after 1970 women gained more power in the household decision making. At the same time, an increasing number of women chose to participate in the labor market instead of specializing in household production. When more women entered the work force or planned to work, the productivity advantage of marriage through gender specialization decreased.

Stevenson and Wolfers (2007) discuss the effect of the changes in the divorce laws in the 1960s on divorce rates and marriage rate. Stevenson (2007) shows that changes in divorce laws led to a decrease in investment in marriage specific human capital. Couples were less likely to have children and more likely to have the wife participate in the labor force.

According to Stevenson and Wolfers, changes in social norms in the end of the twentieth century made cohabitation and childbirth out of wedlock more acceptable. Couples were able to achieve gains similar to gains from marriage without marrying. People could raise children without being socially pressured to marry. These changes contributed to the decline in marriage rates.

3.3 Empirical Studies of Marriages

3.3.1 Cross-sectional Studies

Empirical studies of the decline in the marriage rate in the U.S. at the end of the 20th century typically involve cross-sectional analysis using Census data. Most of cross-sectional studies find support for the "independence hypothesis"—the idea that the women's rising employment and earnings increased her financial independence and decreased her propensity to marry and stay married. In addition, many cross-sectional studies of marriage rates during the 1970–2010 period show that men's worsening economic position negatively affected the marriage rate, although the effect was small. These results are consistent with Becker's (1973) proposition that a fall in gender specialization in society decreases gains from marriage.

Preston and Richards (1975) use 1960 U.S. Census data and find that areas with attractive female employment opportunities had relatively low proportions of women ages 22–24 ever married.

Fossett and Kiecolt (1993) use the 1980 Census data and find that men's socioeconomic status is positively associated with the marriage rate and the women's socioeconomic status is negatively associated with the marriage rate. McLanahan and Casper (1995) use 1970–1990 Census data and find support for the independence hypothesis among white people, but not for the idea that lack of economically well-off men decreased the marriage rate. Blau et al. (2000) use 1970–1990 Census data to show that better female labor market conditions and worse male labor market conditions, measured by wages and unemployment rates for males and females, contributed to lower marriage rate. Wood (1995) uses 1970 and 1980 Census data to demonstrate that the decline in the number of high-earning young black men explains 3 to 4 percent of the decline in the black marriage rate during the 1970s. Lichter et al. (1991) use 1980 Census data to study marital behavior of black and white women. Their findings are consistent with the independence hypothesis and with the idea that deteriorating economic circumstances of men reduced their propensity to marry.

Cross-sectional studies are criticized for the difficulty to show causation using data pertaining to the same time period. Variables measured in the same period are often interdependent. Researchers that use cross-sectional data need to demonstrate that there is no endogeneity or reverse causality, or use correction methods such as instrumental variable regression.

3.3.2 Time Series Studies

Time series analysis of aggregate longitudinal data allows researchers to study long-term trends and patterns as well as short-term relationships at the societal level.

Brown and Kesselring (2006) use yearly data for 1965–2003 from the Current Population Survey to analyze economic causes of the declining marriage rate of black women. They estimate a vector autoregressive (VAR) model with four series: proportion of black females that are married, earnings of black females, ratio of earnings of black females to those of black males, and number of black males with incomes above poverty threshold per 1000 females. They show that the rise in the income of black females, rising wages of black women relative to those of men, and the fall in the proportion of well-earning black males had a negative impact of the marriage rate of black females.

Bremmer and Kesselring (2004) analyze the effect of female labor force participation on divorce prevalence in the U.S. during 1960–1980. Their data include annual divorce rate, labor force participation rate of married women, female income, and birth rate for married women. They find that the time series variables are nonstationary, or drift persistently away from their initial values. A group of nonstationary series may have common stochastic trends, or cointegrating relations, interpreted as the long-term relationships between the variables. Bremmer and Kesselring find that there exists a single long-term relationship between the time series in their study. They fit a vector error correction model (VECM) that includes the cointegrating relation in the model, and look at the responses of divorce rates to shocks in the other variables. They find that greater labor force participation rate of married women and greater female income increase divorce rates. Their results support the independence hypothesis, or the idea that the women's financial independence makes marriage less advantageous for them.

Robert and Ridao-Cano (2005) build a time series model of fertility and female labor supply in the UK. They argue that slowly evolving demographic processes, such as the birth rate and its economic and demographic determinants, are likely to be nonstationary. McNown and Ridao-Cano employ five series: real male wages, real female wages, fertility rate, female labor force participation rate, and male relative cohort size to study determinants of fertility in the U.K. for the period 1972–1999. They find that their series are nonstationary and exhibit two long-term equilibrium relationship. relations between the variables. They show that male wages have a positive and long-run effect on fertility, while female wages have negative and long-run effect on fertility. Their model attributes the rise in fertility associated with the baby boom to the increase in male to female wage ratio, and the subsequent fall in fertility to a decline in the wage ratio.

3.4 Data

I estimate the time series models using three demographic and four economic series. The series include yearly observations for the period 1960–2011. Table 1 contains the definitions of the series. The demographic series are marriage, divorce, and birth rates. In this paper marriage rate is defined as the number of marriages per thousand unmarried women age 15 and over, and divorce rate, as the number of divorces per thousand married women age 15 and over in a given year. Marriage and divorce rates reflect the frequency of marriages among the individuals that are able to marry, and the frequency of divorces among the individuals that can get divorced. [3] Birth rates are the number of births per thousand population. Marriage and divorce rates come from the Historical Statistics of the United States (n.d.) and birth rate, from the Vital Statistics Reports (1960–2011).

The economic series are the labor force participation rates and the median earnings of men and women, obtained from the Current Population Survey in the 2015 IPUMS. The labor force participation rates are the proportions of men or women age 16 and over in the labor force. The median earnings are reported for people age 14 and over that work full-time and year-round. [4]I include the logs of earnings into the time series models to allow for nonlinear effects of earnings on the other series.

Figure 1 contains the plots of the variables over the 1920–2011 period, and Table 2 displays the summary statistics. Labor force participation rates are available beginning in 1948, earnings are available beginning in 1960, and the demographic rates are available beginning in 1920. Male and female labor force participation rates have converged throughout most of the 1948–2011 period. Male earnings increased rapidly during 1960–1973, and oscillated around a constant mean after 1973. Female median earnings increased throughout the whole period. Marriage, divorce, and birth rates experienced a sharp spike in 1946–1947 due to various changes in the society after World War II. Marriage rates declined throughout the post World War II period, with an exception of a relatively minor rise during 1961–1969. During the period of this study, 1960–2011, marriage rates declined by more than half, from 74 to 35 marriages per thousand unmarried women. Divorce rates rose rapidly from 9 to 23 divorces per thousand married women during 1960–1979, and gradually declined after 1979, reaching 17 divorces per thousand married women in 2011. Birth rates were high during the

[3]The marriage and divorce rates are defined for women. I assume that the sex ratios for married and unmarried individuals age 15 and over did not change substantially over the 1960–2011 period. If that is the case, the marriage and divorce rates for men and women exhibit a similar pattern over time.

[4]The Current Population Survey reports earnings for people age 14 and over before 1980, and for people age 15 and over beginning in 1980. Earnings are for civilian workers only before 1989, and for all workers beginning in 1989.

postwar baby boom, and declined from the peak of 25 births per thousand population in 1957 to 15 births per thousand population in 1976. After 1976 birth rates experienced relatively little change.

3.5 Empirical Analysis

3.5.1 Estimation by Ordinary Least Squares

I estimate an ordinary least squares (OLS) model to assess the presence and strength of relationships between the series. In this model I regress marriage rate in a given year on all other variables measured in the same year. I include a time trend variable going from 1 to 52 to allow for a linear change in marriage rate over time.

The results are presented in Table 3. The time trend appears negative. The birth and divorce rates are negative and significant in the OLS estimation of marriage rate. The economic characteristics of women affect the marriage rate at the 10-percent significance level, and the economic characteristics of men do not affect the marriage rate.

The OLS estimates are unbiased, but the standard errors are inaccurate due to the serial correlation in residuals. The marriage rate in any year is correlated with its values in one or more years before, and the residuals of the OLS regression preserve the correlation. When the errors are positively correlated, such as in this case, the standard errors are smaller than the true standard errors and R-squared is overestimated (Greene, 2003). Another issue with the OLS estimation is that it does not demonstrate causality. The marriage rate may be affected by the economic and demographic variables, and may also have an effect on these variables. Reverse causality cannot be avoided by using the values of the variables in previous years as independent variables. The variables in previous years affect marriage rates in previous years, which, in turn, contribute to the current marriage rate. In the following section I present the time series models that describe the relationship between the variables over time and account for the multiple directions of causality.

3.5.2 Specification of Time Series Models

This paper is concerned with the long-run relationships between the economic and the demographic series that affected marriage rates at the end of the 20th century. Time series analysis allows me to study these relationships. I employ vector autoregressive (VAR) and vector error correction (VECM) models. VAR is a linear model describing the data generating process of a small or moderate number of time series. VAR predicts the value of a vector of time series using its values in the past and a set of exogenous variables. Each variable in the VAR depends on its own history and the history of the other variables. VAR leads to correct inferences if the series are stationary, or have time-invariant mean and variance. VAR is also appropriate for trend-stationary series, or series that fluctuate with constant variance around a deterministic trend. When a group of time series is nonstationary, but there are linear combinations of these series that are stationary, the series are said to be cointegrated. VECM describes the data generating process of cointegrated series. VECM is a VAR with restrictions corresponding to the cointegrating relations.

In section 5.2.1 I describe the VAR model and determine the lag order for autoregressive models. In section 5.2.2 I test the series for stationarity, and in sections 5.2.3 I test the series for cointegration, and determine the number of cointegrating relations. Section 5.3 presents the results of estimating the vector error correction model.

Selecting the Lag Order

The lag order of a time series model is the number of periods of history to be included in the model. A VAR of order p (VAR(p)) is

$$y_t = c + \mu t + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + ... + \Phi_p y_{t-p} + u_t, \tag{3.1}$$

where c is vector of constants, μ is a vector of the trend components, and Φ_k is the matrix of coefficients on the variables in the period $t - k$. The lag order should be large enough to capture the dependence of the series on its own history and on the history of the other series. However, if it is too large, the remaining degrees of freedom will be insufficient to estimate the model precisely.

My data consist of 52 observations, and 7 series. I do not consider more than 3 lags for the VAR and the VECM models.

I calculate the Akaike (1998) (AIC), Hannan and Quinn (1979) (HQC), Schwarz (1978) (SIC), and final prediction error (FPE) (Akaike, 1969) information criteria for the VAR models with the lag orders of 1, 2 and 3. The model with the low erst information criterion should be chosen. AIC is minimized when the lag order is 3, and HQC, SIC, and FPE are minimized when the lag order is 1. Lütkepohl and Krätzig (2004) note that AIC and FPE are not asymptotically consistent, and tend to over-predict the number of lags that should be included in the model. Then, the asymptotically consistent information criteria, HQC and SIC, are more reliable if there are conflicting results.

I set the lag order to 1 and estimate the VAR model with the labor force participation rates and earnings of men and women, and marriage divorce and birth rates. I test the residuals of the model for autocorrelation over one or several periods to see if VAR(1) captures the serial correlation in the series. I find that the residuals of the birth rate and male labor force participation rate equations are autocorrelated over 1–4 periods. [5] Then, a single lag of the series in the VAR model is insufficient to capture all autocorrelation present in the data. I fit VAR(2) and test the residuals for autocorrelation. The Ljung and Box (1978) test does not find autocorrelation in the residuals. I conclude that the VAR lag order should be at least 2.

Stationarity and Order of Integration

A VAR is appropriate if each time series variable is stationary or trend-stationary. A stationary series has a time-invariant mean and variance. A trend-stationary series becomes stationary after subtracting a deterministic trend. Figure 2 plots the data used in empirical analysis, the annual series over 1960–2011. According to the plots, the series do not appear to fluctuate with constant variance around a linear time trend. The gradual change in the statistical properties of the data over time is particularly apparent for the demographic series. I perform formal tests to determine

[5] I perform the Ljung-Box test (Ljung and Box, 1978) that tests the presence of correlation between observations separated by 1 through 4 periods. The hypothesis of no autocorrelation is rejected at 1-percent level for the residuals from the birth rate and male labor force participation rate equations in the VAR(1) model.

if the series are in fact nonstationary.

A nonstationary variable can often be made stationary by taking a difference between the values in two consecutive periods, or differencing. A nonstationary process that can be made stationary by differencing it k times is said to be integrated of order k (I(k)). I do not expect the series used in this analysis to have an integration order above 1. A process with an order of integration of 2 or more is referred to as explosive, because it has a diverging mean or variance. The values of an explosive process approach infinity over time (Lütkepohl and Krätzig, 2004). Some examples of explosive processes are macroeconomic and financial variables during hyperinflation. I do not expect the economic and the demographic series used in this paper to exhibit explosive dynamics. The labor force participation rates are naturally bounded, the logs of earnings grow at a decreasing rate, and the demographic rates are falling for most of the time and bounded from below. The only series that changed at an increasing rate is divorce rate during 1960–1973.

I test the series for stationarity and the order of integration using unit root and stationarity tests. A unit root test has a null hypothesis that the data is I(1), or unit root. A stationarity test has the reverse null hypothesis that the data is stationary. If a series is stationary, the stationarity test should fail to reject the hypothesis of stationarity, and the unit root test should reject the hypothesis of the presence of a unit root.

I can describe the unit root and stationarity tests using an example of an autoregressive process with 1 lag (AR(1)). The AR(1) process is generated by

$$Y_t = \theta_0 + \theta Y_{t-1} + u_t, \tag{3.2}$$

where u_t is normal and iid. The null hypothesis of the unit root test is that $\theta = 1$. If $\theta = 1$, the error from the previous period persists fully into the current period, and the series drifts randomly. The null hypothesis of the stationarity test is that $\theta < 1$. If $\theta < 1$, only a portion of the error from one period carries over to the next period, and the series can revert to a time-invariant mean. I am not concerned with explosive series that have $\theta > 1$.

Subtracting Y_{t-1} from both sides of the equation (3.2), we have

$$\Delta Y_t = \theta_0 + \sigma Y_{t-1} + u_t, \tag{3.3}$$

where ΔY_t is the first difference of Y_t. The unit root test, such as the Dickey and Fuller (1979) test, has the null hypothesis that $\sigma = 0$.

I employ three unit root tests, the augmented Dickey-Fuller (ADF), the Elliot, Rothenberg and Stock (ERS), and the Zivot-Andrews (ZA) tests. The ADF test is a widely-used modification of the Dickey-Fuller test that accounts for the unknown lag order in the autoregressive process, and remaining autocorrelation in the error term (Said and Dickey, 1984). The ERS test transforms the data before performing the ADF test and achieves optimal power among unit root tests (Elliott et al., 1996) . The ADF and ERS tests can fail to reject the presence of a unit root in a stationary series that has breaks in the mean or trend. The ZA test assesses the null hypothesis of unit root against the alternative hypothesis of stationarity with a break (Zivot and Andrews, 1990). The location of the break is determined from the data. Finally, I perform the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test with the null hypothesis of stationarity (Kwiatkowski et al., 1992).

The test statistics for the unit root and stationarity tests are reported in Table 4, and the critical values for the tests are provided in Table 5. I find evidence for nonstationarity of all series except marriage rate. The ADF and ZA test reject the presence of a unit root in marriage rate, while the ERS test does not. I suppose that the 1962–1973 bump in the marriage rate may affect the results of the unit root tests. To test this idea, I examine whether marriage rate is stationary after 1973. All unit root tests cannot reject the presence of a unit root in the marriage rate after 1973. I conclude that marriage rate is unit root. I include a dummy variable for the years after 1973 into the time series models to account for the possible differences in the behavior of the series before and after 1973. Another reason for including the after 1973 dummy variable is that the ZA test finds that 1973 is the most likely location of a structural break in the male earnings and birth rate series.

I test the first differences of the series for stationarity using the unit root and stationarity tests.

A nonstationary first difference of a series means that the order of integration of the series is above 1, and the series is explosive. The results are displayed in Table 4. The tests reject the presence of unit root, and do not reject stationarity of the first differences of male labor force participation rate and marriage rate. The results for the other series are conflicting. The test results cannot reject the presence of a unit root in the female labor force participation. Female labor force participation rate is bounded by 0 and 100, and does not grow exponentially. Therefore, the test results are likely due to the relatively small sample of my study. In small samples, the unit root and stationarity tests suffer from low power and sensitivity to structural breaks, potential heteroscedasticity, and autocorrelation not fully captured in the autoregressive model (Lütkepohl and Krätzig, 2004). The first difference of divorce rate is nonstationary, according to three out of four tests. Divorce rate may appear nonstationary due to the explosive behavior of divorce rates during the period of accelerating growth during 1960–1973. Divorce rates after 1973 are stationary according to two out of four tests.

Testing for Cointegration

I find the series to be integrated of order one. I test for the presence of cointegrating relations, or linear combinations of the series that are stationary. A group of series that are integrated of order 1 and cointegrated, or exhibit cointegrating relations, can be described using a vector error correction (VECM) model. If the I(1) series are not cointegrated, a vector autoregressive (VAR) model can be applied to the stationary first differences of the series.

I perform a Johansen (1991) trace and maximum eigenvalue tests for cointegration. The null hypotheses of the trace and maximum eigenvalue tests are that the number of cointegrating relations r is r^*, for all r^* less than the number of the variables. The cointegrating tests differ in their alternative hypotheses. The alternative hypothesis of the trace test is that the number of cointegrating relations is greater than r^*, and the alternative hypothesis of the maximum eigenvalue test is that the number of cointegrating relations is equal to $r^* + 1$.

The test is based on a VAR model with 2 lags, a deterministic trend, and an observation range dummy variable equal to one for observations in years after 1973. The trend is included to accurately model such series as labor force participation rates and earning that appear to be trending. The observation range dummy allows for the cointegrating relations and short run interactions to have different means before and after 1973. [6]

The results of the tests are reported in Table 6. The trace and maximum eigenvalue tests cannot reject the null hypothesis that the number of cointegrating relations r is 6. Then, r is less than 7, and the series are nonstationary. If the series were stationary, there would be seven linear combinations of variables that are stationary. Each linear combination of variables would have the coefficient 1 on one of the variables, and 0 on all other variables. The Johansen trace and maximum eigenvalue tests reject the null hypothesis that r is 0 at 1-percent level, and cannot reject the null hypothesis that r is 1. I conclude that there is one cointegrating relation in the data.

3.5.3 Estimating the Vector Error Correction Model

I find that the series exhibit a single cointegrating relation, and estimate a vector error correction model (VECM). The VECM includes a cointegrating relation, interpreted as the long-run equilibrium between the variables, and the error correction mechanism that returns the system to the equilibrium. The error correction mechanism is modeled as a vector autoregressive process with the first differences of the series.

The VECM model is a representation of a VAR process with two lags and a structural shift in year 1973. The VAR model is

$$y_t = c + \mu t + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \delta d_t + u_t, \tag{3.4}$$

where c and μ are deterministic constant and trend terms, Φ_1 and Φ_2 contain the coefficients on the lagged endogenous variables, and d_t is the observation range dummy.

The VECM representation of equation (3.4) is obtained by subtraction Y_t from both sides. The

[6] Marriage and divorce rates exhibit different dynamics before and after 1973. I find that ignoring this difference leads to implausible results of unit root tests. See section 5.2 for the complete discussion. In addition, Zivot Andrews unit root test suggests that birth rates and male earnings exhibit a structural break in 1973.

VECM with one cointegrating relation is

$$\Delta Y_t = \Gamma \Delta Y_{t-1} + \alpha\beta Y_{t-1} + \delta d_t + u_t. \tag{3.5}$$

where ΔY_t denotes the first difference of the vector of variables Y_t, βY_{t-1} contains the cointegrating relation, and α is the adjustment vector. There is no unique way to separate the constant term between the cointegrating relation and the short-run portion of the model $\Gamma \Delta Y_{t-1}$. Therefore, the model does not explicitly include the constant.

I estimate the VECM described in equation 3.5 using the seven time series for years 1960–2011 and a dummy variable for data after 1973. I test if the model is an accurate representation of the data generating process by examining the residuals of the model for regularity. I find that the residuals of the seven VECM equations are not autocorrelated, are multivariate normal, and exhibit no autoregressive conditional heteroskedasticity (ARCH).

The coefficients of the cointegration equation, β, are reported in Table 7. The coefficient on the marriage rate is normalized to 1 for ease of interpretation. [7] I find that marriage rate and labor force participation rates are statistically significant in the cointegrating relation, and birth rate is borderline significant, with the p-value of 5.01 percent. [8]

In the cointegrating relation marriage rate is negatively related to birth rate and positively related to male and female labor force participation rates. The coefficient on male labor force participation rate is larger in absolute value and more statistically significant than the coefficient on female labor force participation rate, suggesting that the positive relationship between male labor force participation rate and marriage rate is stronger than that between female labor force participation rate and marriage rate.

The positive relationship between male labor force participation rate and marriage rate is consistent with Becker's idea about gains to marriage through gender specialization. The positive

[7] The coefficient on the marriage rate is statistically different from 0, according to the likelihood ratio test. Then, I can set it to 1 by dividing all estimates of the coefficients by it.

[8] I assess the significance of the coefficients in the cointegrating relation using the likelihood ratio test. The test compares the model in which the coefficient on one of the variables in the cointegrating relation is restricted to 0 to the unrestricted VECM model.

relationship between female labor force participation rate and marriage rate is inconsistent with Becker's economic theory of marriage and the independence hypothesis. However, the signs and the significance of the coefficients in the cointegrating relation do not indicate causation, because the cointegrating relation is a relationship between the series measured in the same year. In section 5.2.6 I compute impulse response functions to examine the response of the marriage rate to an independent shock in each of the variables.

Table 8 presents the estimates of the adjustment vector (α) of equation (3.5). The vector α can be interpreted as the adjustment of the series to the deviations from the equilibrium relation. The estimates of α have the opposite sign of the estimates of β for all series that are part of the cointegrating relation, or all series, except divorce rate and male earnings. Then, the cointegrating relation is dynamically stable. When a variable in the cointegrating relation is above the equilibrium, a positive β increases the value of the cointegrating relation, and a negative α decreases the value of the first difference of the variable, pushing the variable back to equilibrium. When β and α have the same sign, a deviation of a variable away from equilibrium causes it to move further in the same direction through its short run equation.

Table 9 displays the short-run dynamics of the first difference of marriage rate in th VECM. I do not find a statistically significant effect of the first differences of the other series on the first difference of marriage rate. The only variable that affects the first difference of marriage rate is the dummy variable for the period after 1973. The cointegrating relation does not have a statistically significant effect on the marriage rate in the short-run.

In the following section I describe a structural representation of the VECM that allows me to compute impulse responses and measure the effects that independent shocks to other variables have on the marriage rate.

Structural Representation of the VECM

The vector error correction model can be represented as a structural system with uncorrelated shocks. I construct the structural shocks and analyze the impact of independent shocks to the series on the development of a particular series over time. I focus on the responses of the marriage rate to structural shocks, but also briefly discuss the responses of the other variables to shocks.

The series in this study are correlated, and the disturbances to the individual series in the VAR and VECM processes do not happen in isolation. To construct orthogonal shocks I represent the VECM process as a structural VECM via the Choleski decomposition (Lütkepohl and Krätzig, 2004).

The ordering of the variables in the structural time series model affects the construction of the orthogonal shocks and the interpretation of results. The first variable should be the only variable with the possible contemporaneous impact on all other variables. In addition, the first variable cannot be immediately impacted by the other variables. The second variable may have an immediate impact on all other variables except the first, and can only be affected by the first variable. The third variable may contemporaneously impact variables 4–7, but not 1 and 2, etc. The last variable in the ordering does not impact the other variables in the same year, but may be impacted by them.

The first structural shock is the shock to the first variable. The second structural shock is the portion of the shock to the second variable orthogonal to the first variable , and the third structural shock is the portion of the shock in the third variable orthogonal to the first two variables, etc. The last structural shock is the portion of the shock to the last variable in the ordering orthogonal to all other variables.

I choose the following orthogonal ordering: birth rate, divorce rate, marriage rate, male and female earnings, and male and female labor force participation rates. In my ordering, the demographic variables come before the economic variables because they are slower to react and are unlikely to react to the economic variables in the same year. Birth rate is the first variable, because I assume that it is the slowest to react. Divorce rate is the second, and marriage rate, the third. Marriage rate may be immediately affected by divorce rate, when, for instance, people divorce in order to remarry. Marriage rate may also react to birth rates in the same year, when couple get married after getting pregnant. [9]

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[9]In my choice of the orthogonal ordering I assume that birth rate does not react to marriage rate within the same year. Pregnancy and birth may follow marriage soon, and may occur within the same year. However, I assume that

I place the economic characteristics of men before those of women in the orthogonal ordering. I assume that female earnings and labor supply react to those of men more than male earnings and labor supply, to those of women. Labor supply of men in the U.S. during 1960–2011 was more rigid than female labor supply (Blundell and Macurdy, 1999; Evers et al., 2008).

I assume that earnings are sticky and do not react to the shocks in labor force participation rates within the same year. The earnings data consist of median earnings for men and women who work full-time and year-round. The variation in earnings comes mostly though the variation in wages, which exhibit wage inertia. The labor force participation rates, on the other hand, may react to the shocks in earnings within the same year. [10]

Impulse Response Functions and Variance Decomposition of The Marriage Rate

I use the orthogonalized shocks described in section 5.2.5 to construct impulse response functions (IRFs). The IRFs show the responses of each variable to the orthogonalized shocks to all variables. Figure 3 plots the responses of the marriage rate to the orthogonal shocks in the other series. The plot includes the 95-percent confidence intervals.

I find that the shock to female earnings has a negative effect on the marriage rate that becomes statistically significant after two years and grows over time. The only other shock that impacts the marriage rate is the shock to the marriage rate itself.

A one period increase in female earnings by 1,000 dollars leads to a fall in the marriage rate by 0.5 over 5 years, and 0.7 over 15 or more years. Female median yearly earnings increased by 17 thousand dollars during 1960–2010. Positive shocks to female earnings that contributed to the rapid increase in female earnings during the period, also led to a fall in the marriage rate.

The last graph in Figure 3 shows the forecast error variance decomposition (FEVD) of the marriage rate over 25 years. FEVD shows the contributions of each variable to the deviation in

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marriages are quicker to react than births. I change the ordering and place marriage rate first and birth rate second or third. The resulting causal relationships between marriage rate and the other variables are not affected.

[10]For completeness I perform impulse response analysis for the orthogonal ordering in which labor force participation rates come before earnings. This ordering assumes that there is little wage rigidity, and labor force participation rates do not react to shocks in earnings contemporaneously. The results are similar to the results that I obtain with the original ordering.

the marriage rate away from the values predicted by the model up to 25 years in advance. In the short-term forecasts the forecast error of the marriage rate is largely determined by its own error. In the 25-year forecast marriage rate contributes 37 percent to its own variance, female earnings, 27 percent, birth rate, 17 percent, and the other series each contribute less than 10 percent to the variance in the marriage rate.

Impulse Response Analysis for All Variables

Figure 4 displays the statistically significant responses of the variables in the model to the independent shocks to the other variables. The impulse response functions are based on the estimated vector error correction model. I display the responses over 10 years to illustrate that some responses are not statistically significant after the first years. The impulse response functions exhibit little change after 10 years.

Only the shocks to the marriage rate and the median earnings affect the variables in the model. I interpret the responses of the variables to an independent increase in the marriage rate as an impact of marriage on couples. The individuals that do not marry can be affected by an increase in the marriage rate, but the changes in their behavior are likely to be small, compared to the changes in the behavior of the people that marry.

A positive shock to the marriage rate increases the birth rate in the first four years, and increases the labor force participation rates of men and women. Marriage increases the couple's inclination to have children, or to have additional children. Men that marry are more likely to join the labor force, and women are more likely to join the labor force in the first three years after marriage.

An independent increase in male earnings leads to an increase in the birth rate in the first year, an increase in female earnings, and an increase in female labor force participation rate. An increase in the median earnings makes people optimistic about the economy and increases their willingness to have more children. Impulse response analysis suggests that female labor force participation is elastic to wage, while male labor force participation rate is not.

An independent increase in female earnings leads to an increase in divorce rate in the first five years and a fall in the marriage rate. When the women's earnings or potential earnings increase, and the men's earnings stay the same, couples are less inclined to marry, and more inclined to divorce. These results support the importance of gender specialization in marriage and support the hypothesis that the economic independence of women reduces their willingness to marry and stay married.

3.6 Conclusions

This paper examines the reasons for the decline in the marriage rate in the U.S. during 1960–2011. The theory of marriage described in Becker's 1973 *Theory of Marriage* attributes gains from marriage to gender specialization. It predicts that the variables associated with the specialization of men in market work, such as men's wages and the labor force participation rate of men, have a positive effect on the marriage rate, and the variables associated with greater participation of women in market work and greater profitability of market work for women have a negative effect on the marriage rate.

Stevenson and Wolfers (2007) argue that the gains from marriage due to gender specialization became less important at the end of the 20th century. They mention complementarities of consumption as important contributors to the gains from marriage. Other changes happening in the U.S. during this period such as the availability of the contraceptive pill, the improvements in household technology, and the cultural changes that made cohabitation more acceptable may have affected marriage rates.

I apply time series analysis to estimate the relationship between the marriage rate and the economic and the demographic characteristics of men and women during 1960–2011. I use aggregate-level data for yearly marriage, divorce, and birth rates, labor force participation rates of men and women, and median earnings for working men and women. I find that all variables are nonstationary and exhibit a long-run stationary relationship. In the long-run the marriage rate is positively associated with male and female labor force participation rates. The coefficient on the male labor force participation rate is over 2 times greater. The other series are not part of the long-term relationship. The changes in the labor force participation rates during 1960–2011 are associated with about a quarter of the fall in the marriage rate. The male labor force participation rate fell during the period and had a negative effect on the marriage rate, and female labor force participation rate increased and had a positive, but smaller, effect on marriage rate.

The estimated cointegrating relation supports the idea that financial independence of men and women promotes marriage, and counters the independence hypothesis that states that the women's financial independence makes marriage less desirable for them. In the economic theory of marriage, labor force participation of men and women increases income and increases gains from marriage through economies of scale. The couple can produce more in the family if the inputs are greater due to higher labor income. The estimated cointegrating relation suggests that in the long run the positive impact of the rise female labor force participation rate on the marriage rate is greater than the negative effect that may come due to decreased gender specialization in the society.

I build a vector error correction model and estimate structural impulse responses. The impulse response analysis shows that an independent positive shock to female earnings leads to a permanent fall in the marriage rate. Shocks to other variables do not affect the marriage rate significantly. In the long run 30 percent of the variation in the marriage rate can be attributed to the female earnings shocks. The marriage rate shocks explain 30 percent of the variance in the marriage rate, and the shocks to the other variables each contribute 20 percent or less to the marriage rate variance. Then the fall in the marriage rate that occurred through the variation of the marriage rate away from its predicted values can be mostly attributed to the positive shocks to the marriage rate itself and to female earnings.

I find that a positive shock to female earnings increases the divorce rate in the first five years after the shock. According to the economic theory of marriage, greater median earnings for working women can increase the gains from marriage by increasing the resources available for the couple. On the other hand, greater female wages, controlling for male wages, represents lower gender specialization in society. My data suggest that the total effect of an independent increase in female earnings on the willingness of people to marry and stay married is negative.

Time series analysis allows me to examine the relationships between the marriage rate and the other demographic and economic processes during 1960-2011. I find that the marriage rate exhibits a long-term relationship with the male and female labor force participation rates. The cointegrating relation indicates comovement, but not causation. A possible interpretation of my results is that higher labor force participation rates are associated with the period of rapid economic growth that may also be associated with more marriages. During the contraction stage of the business cycle labor force participation stagnates and at the same time people are less optimistic and willing to marry. The impulse response analysis is able to demonstrate causation, because it shows the impact of an independent shock to one variable on another variable over time. I find that a positive shock to female earnings decreases the marriage rate.

A positive shock to the marriage rate increases the labor force participation rates of men and women. According to my data, marriage encourages men and women to enter the labor force.

The estimated long-run relationship between the marriage rate and the labor force participation rates suggests that the marriage rate will not continue to fall at the same rate. The next economic expansion will likely lead to greater labor force participation, which is associated with greater marriage rate. This model does not address other factors, such as the changes in the cultural norms, the timing of marriage and childbirth, and the rise in cohabitation, that influence and continue to influence the prevalence of marriage.

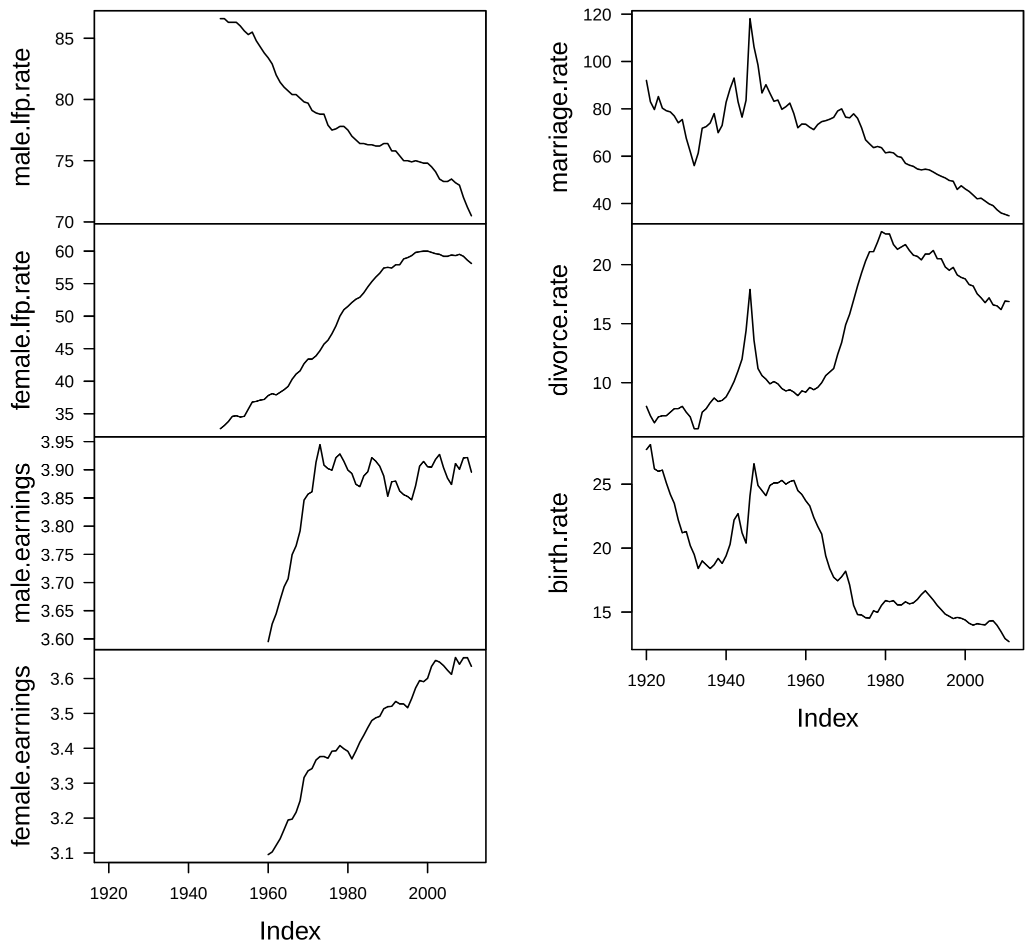
3.7 Tables and Figures

Table 3.1: Variables of the Time Series Model

	Variable Description
Male.lfp.rate	Proportion of men age 16 and over in the labor force
Female.lfp.rate	Proportion of women age 16 and over in the labor force
Male.earnings	Log of median yearly earnings for men working full-time year-round[1]
Female.earnings	Log of median yearly earnings for women working full-time year-round[1]
Marriage.rate	Number of marriages per 1,000 unmarried women age 15 and over
Divorce.rate	Number of divorces per 1,000 married women age 15 and over
Birth.rate	Number of births per 1,000 of population

[1] The earnings are in 1,000 of 2012 dollars

Figure 3.1: Economic and Demographic Characteristics of Men and Women in the U.S., 1920-2011



Data Sources: Current Population Survey, Bureau of Labor Statistics; The World Top Incomes Database,Facundo Alvaredo, Tony Atkinson, Thomas Piketty and Emmanuel Saez; U.S. National Center for Health Statistics,Vital Statistics of the United States, and National Vital Statistics Reports.

Notes: Labor force participation rates are the proportions of men and women ages 16 years and over that are in the labor force. Earnings are the logs of median earnings of men and women in thousands of 2012 dollars. Demographic rates are the number of marriages per 1,000 unmarried women ages 15 and over, number of divorces per 1,000 married women age 15 and over, and number of births per 1,000 of population.

Table 3.2: Summary Statistics for the Annual Series 1960-2011

	Min	Year of Min	Max	Year of Max	Mean	Std. Dev
Male.lfp.rate	70.50	2011	83.40	1960	76.76	2.97
Female.lfp.rate	37.80	1960	60.00	1999	51.95	7.85
Male.earnings	3.60	1960	3.94	1973	3.86	0.08
Female.earnings	3.10	1960	3.66	2007	3.44	0.16
Marriage.rate	34.82	2011	80.00	1969	58.20	13.59
Divorce.rate	9.20	1960	22.80	1979	17.72	4.02
Birth.rate	12.69	2011	23.70	1960	16.06	2.52

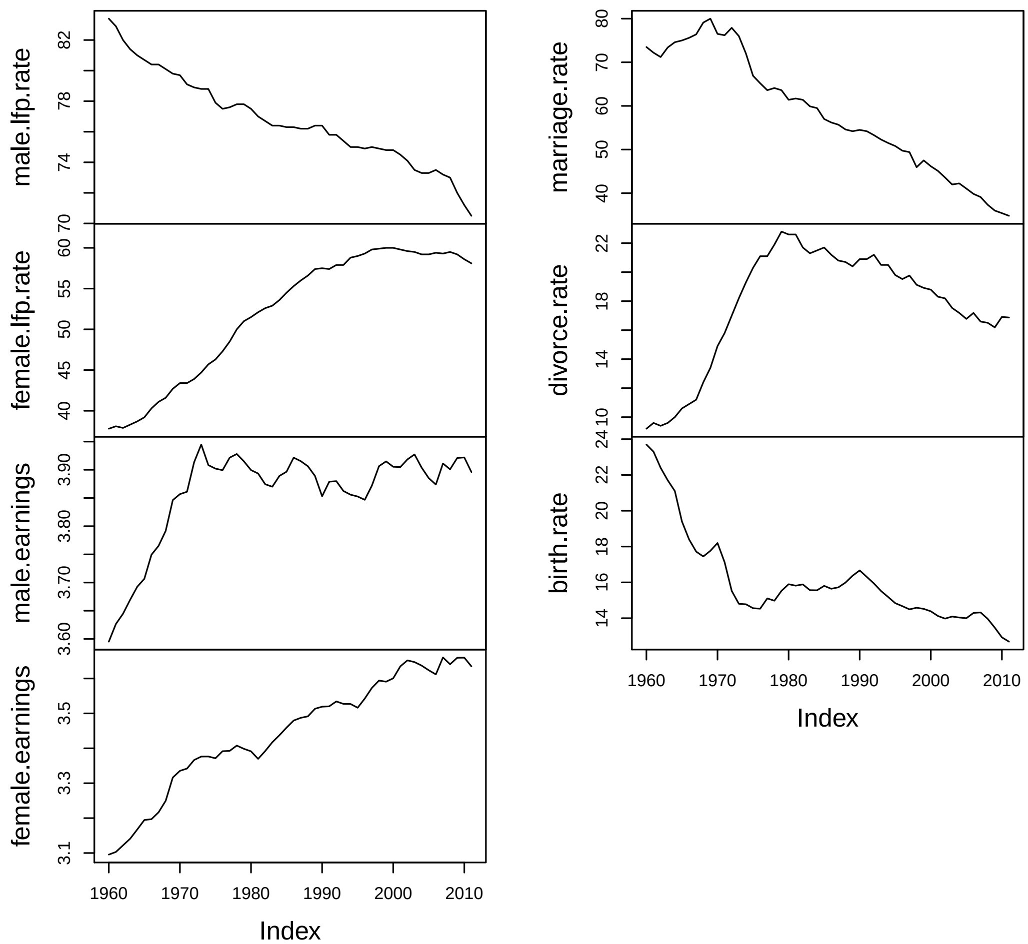
Notes: The sample consists of 52 annual observations.

Table 3.3: Ordinary Least Squares. Dependent Variable is The Marriage Rate. Explanatory Variables are the Other Series Recorded in the Same Year, and the Time Trend.

	Estimate	Std. Error	T-Value	Pr (>|t|)
Linear trend	−1.674	0.269	−6.217	0.000
Male.lfp.rate	−0.337	0.823	−0.409	0.685
Female.lfp.rate	0.584	0.294	1.990	0.053
Male.earnings	10.702	17.504	0.611	0.544
Female.earnings	32.799	18.440	1.779	0.082
Divorce.rate	−0.937	0.274	−3.423	0.001
Birth.rate	−1.371	0.469	−2.921	0.005

Notes: The sample consists of 52 annual observations. Adjusted R-squared: 0.98

Figure 3.2: Series used in Time Series Analysis, 1960-2011



Data Sources: Bureau of Labor Statistics, and Center for Disease Control and Prevention.

3.7.1 Testing for Stationarity

Table 3.4: Testing for Stationarity of the Series and the First Difference of the Series

	ADF	ERS	ZA	KPSS
Series in levels				
Male.lfp.rate	−1.887	−1.343	−2.978	0.193**
Female.lfp.rate	0.794	−0.901	−2.143	0.332***
Male.earnings	−2.981	−1.201	−4.159	0.237***
Female.earnings	−2.224	−1.353	−3.569	0.202**
Marriage.rate	−3.396**	−2.048	−5.097**	0.095
Marriage.rate, 1974–2011	−1.417	−2.182	−3.853	0.126*
Divorce.rate	−2.271	−1.259	−4.630	0.533**
Birth.rate	−3.088	−1.591	−3.982	0.195**
First differences of the series				
Male.lfp.rate	−4.171***	−2.903***	−5.735***	0.185
Female.lfp.rate	−1.076	−1.198	−4.227	1.013***
Male.earnings	−3.057**	−2.252**	−5.643***	0.598**
Female.earnings	−3.498**	−3.420***	−4.793*	0.398*
Marriage.rate	−3.473**	−3.464***	−5.330**	0.206
Divorce.rate	−1.712*	−1.786*	−4.907**	0.902***
Divorce.rate, 1974-2011	−1.908*	−1.995**	−4.667*	1.243
Birth.rate	−3.071**	−2.928***	−4.733*	0.398*

Notes: The sample consists of 52 annual observations. The critical values are based on the sample of size 50, and are reported in Table 5.
The null hypothesis for the ADF, ERS tests is that the series is unit root. The ZA test has the null hypothesis that the series is unit root and the alternative hypothesis that the series is stationary with a break in the intercept or trend. The KPSS test has the null hypothesis that the series is stationary.
The tests are based on an autoregressive model with 2 lags and a trend for all series, except divorce rate. The model for the first differences of the series includes an intercept for all series, except divorce rate, and no time trend. I include a trend when the series exhibits a linear time trend during 1960–2011 that is not caused by any of the other series used in this analysis. For example, earnings are likely to increase over time. The changes in the social norms and the wider use of contraceptive technology may have led to a fall in birth rates and marriage rates during the period. Divorce rate, on the other hand, is closely linked to past marriage rates, and is unlikely to exhibit a time trend not caused by the other series. The changes in divorce laws during 1967-1979 led to a sharp increase in divorce rate. However, the increase was temporary.
*, **, and *** represent rejection of the null hypothesis that elasticity is 0 at the 10-percent, 5-percent levels, and 1-percent levels, respectively.

Table 3.5: Critical Values for ADF, ERS, ZA, and KPSS Tests

Test and Model Type	Level 1%	5%	10%
ADF test including a linear trend	−4.04	−3.45	−3.15
ADF test without a trend	−3.51	−2.89	−2.58
ADF test without an intercept	−2.60	−1.95	−1.61
ERS test including a linear trend	−3.58	−3.03	−2.74
ERS test without a trend	−2.60	−1.95	−1.62
ZA test: break in the intercept or trend	−5.57	−5.08	−4.82
ZA test: break in the intercept	−5.34	−4.80	−4.58
KPSS test including a linear trend	0.216	0.146	0.119
KPSS test without a trend	0.739	0.463	0.347

Notes: The critical values are based on the sample size of 50. The critical values are taken from MacKinnon (2010) and Table 1 of of Elliot, Rothenberg and Stock (1996).

3.7.2 Testing for Cointegration

Table 3.6: Johansen Trace and Maximum Eigenvalue Tests for the Presence of Cointegration among the Series

	Trace Test	P-Value	Maximum Eigenvalue Test	P-Value
$r^* = 0$	159.25	0.007	54.30	0.004
$r^* = 1$	104.95	0.074	37.19	0.101
$r^* = 2$	67.77	0.189	27.05	0.270
$r^* = 3$	40.71	0.312	23.32	0.164
$r^* = 4$	17.40	0.678	13.30	0.439
$r^* = 5$	4.10	0.899	3.87	0.866
$r^* = 6$	0.23	0.642	0.23	0.628

Notes: The sample consists of 52 annual observations, and seven time series. The model includes two lags, and an observation range dummy for data after 1973.

The null hypotheses of the cointegration tests is that the number of cointegrating relations r is r^*. The trace test has the alternative hypothesis that $r > r^*$, and the maximal eigenvalue test has the alternative hypothesis that $r = r^* + 1$. P-values are computed using the Doornik (1998) approximation. The p-values for the trace test are adjusted for the sample size.

Table 3.7: Estimation of the Cointegrating Relation (β in Equation 3.5) in the Vector Error Correction Model.

	Estimate	Std. Error	P-Value[1]
Marriage.rate	1.00	0.17	0.000
Birth.rate	1.92	0.62	0.050
Divorce.rate	0.35	0.41	0.658
Male.lfp.rate	−3.44	0.75	0.002
Female.lfp.rate	−1.72	0.45	0.040
Male.earnings	−39.03	24.25	0.365
Female.earnings	88.78	24.87	0.053

Notes: The sample consists of 52 annual observations. I estimate a VECM with two lags and one cointegrating relation. The model includes a dummy variable for years after 1973.

[1] I report the p-values of the likelihood ratio tests. The tests compare the unrestricted VECM with the VECM, in which the coefficient on a variable in the cointegrating relation is restricted to 0. The null hypothesis of the test is that the restriction does not reduce the likelihood of the model.

Table 3.8: Estimation of the Adjustment Vector (α in Equation 3.5) in the Vector Error Correction Model.

	Estimate	Std. Error	T-Value	Pr (>|t|)
Marriage.rate	−0.101	0.062	−1.631	0.111
Birth.rate	−0.013	0.018	−0.754	0.456
Divorce.rate	0.081	0.022	3.634	0.001
Male.lfp.rate	0.024	0.013	1.875	0.068
Female.lfp.rate	0.064	0.016	3.904	0.000
Male.earnings	−0.002	0.001	−1.849	0.072
Female.earnings	−0.001	0.001	−0.904	0.371

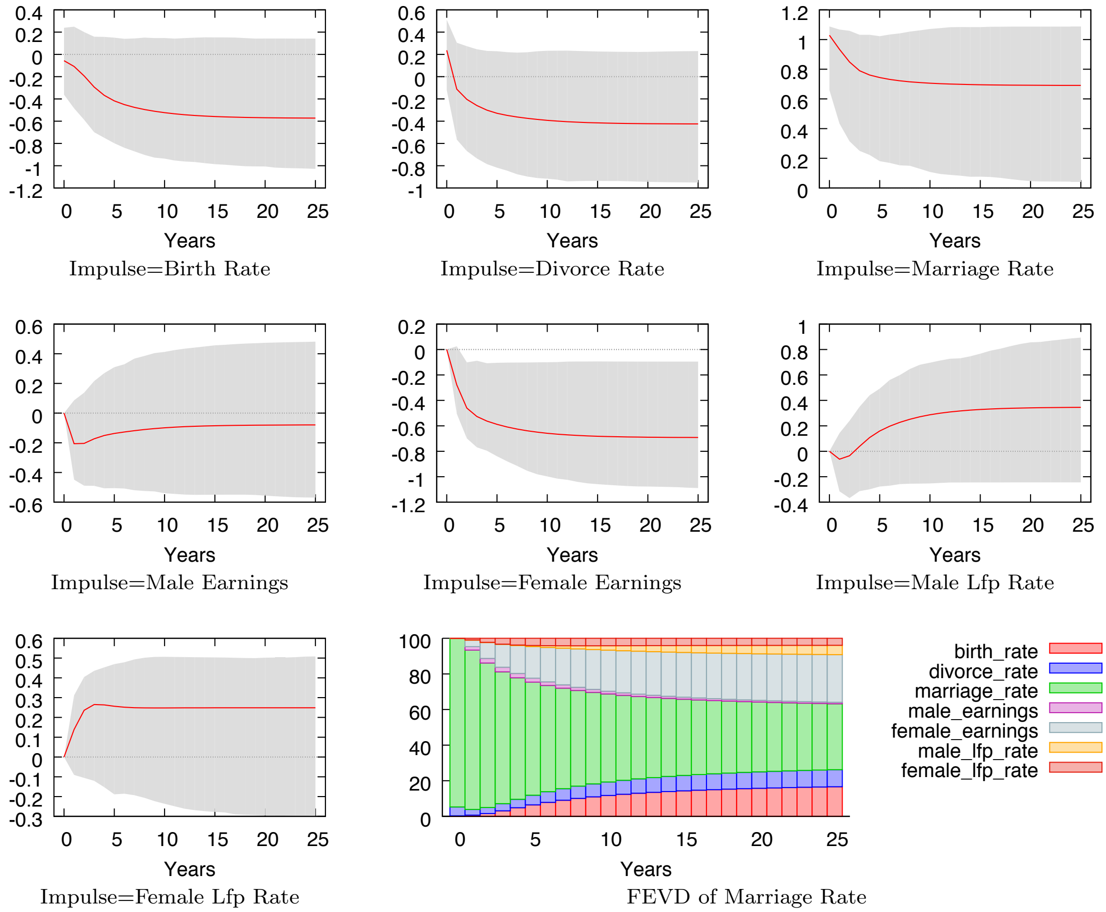
Notes: The sample consists of 52 annual observations. I estimate a VECM with two lags and one cointegrating relation. The model includes a dummy variable for years after 1973.

Table 3.9: Δ Marriage Rate Equation in the VECM (lag=2, r=1). Dependent Variable is the First Difference of The Marriage Rate at Time t.

	Estimate	Std. Error	T-Value	Pr (>|t|)
ΔMarriage.rate$_{t-1}$	0.006	0.138	0.044	0.966
Δ Birth.rate$_{t-1}$	0.124	0.477	0.258	0.797
ΔDivorce.rate$_{t-1}$	−0.826	0.455	−1.813	0.077
ΔMale.lfp.rate$_{t-1}$	−0.901	0.807	−1.117	0.270
ΔFemale.lfp.rate$_{t-1}$	0.522	0.551	0.949	0.348
ΔMale.earnings$_{t-1}$	−10.276	11.276	−0.911	0.367
ΔFemale.earnings$_{t-1}$	−12.498	12.750	−0.980	0.333
Year After 1973	−3.909	0.953	−4.104	0.000
Cointegrating relation	−0.101	0.062	−1.631	0.111

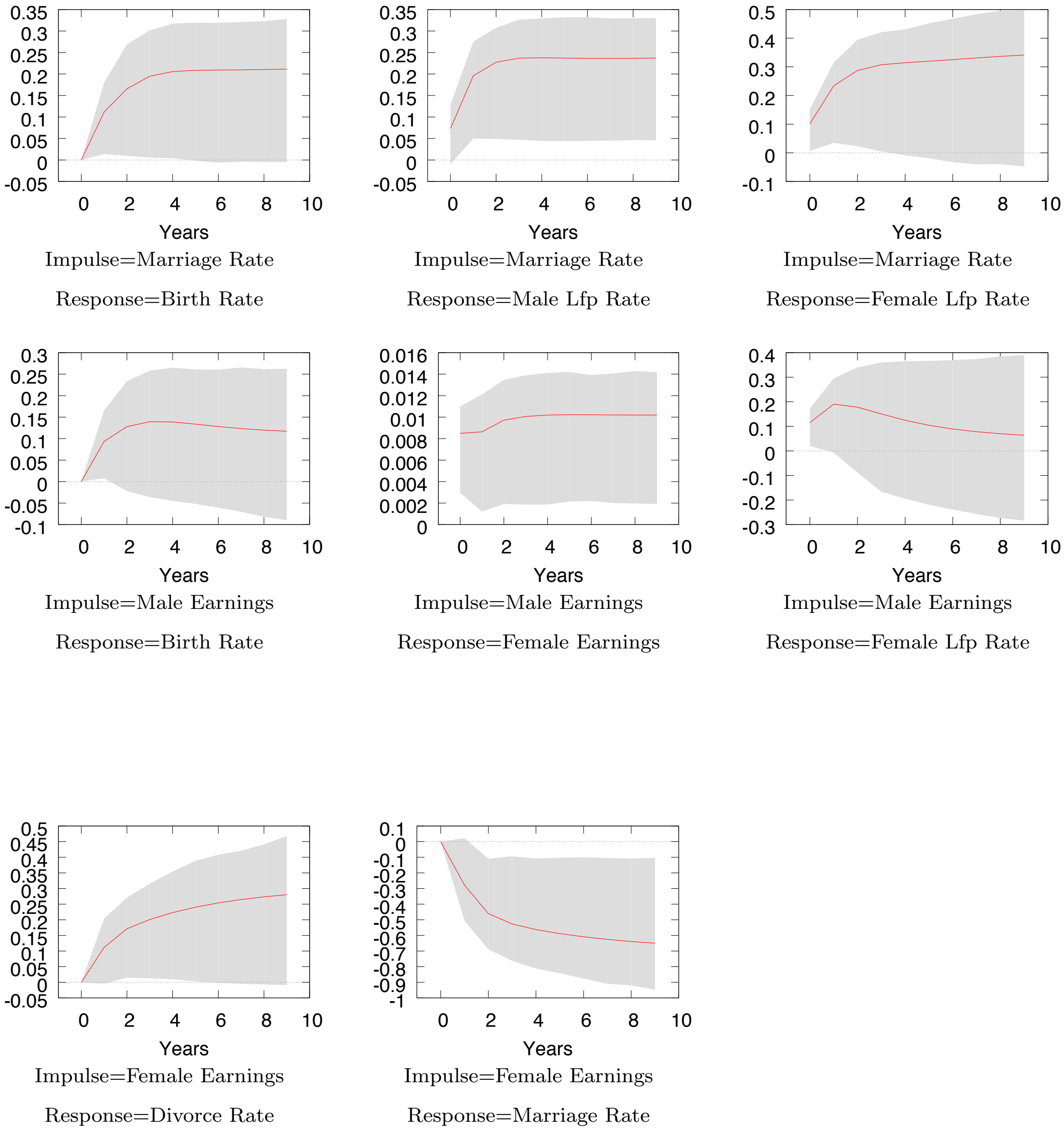
Notes: The sample consists of 52 annual observations. The model is VECM with two lags and one cointegrating relation. The sum of squared residuals: 55.92. Adjusted R-squared: 0.36

Figure 3.3: Impulse Response Functions From the Vector Error Correction Model. The Response Variable Is The Marriage Rate.



Notes: Y-axis represents the responses of the marriage rate to one standard error shocks. The gray bands are the 95 percent bootstrap confidence intervals.

Figure 3.4: Impulse Response Functions From the Vector Error Correction Model



Notes: Y-axis represents the responses of the variables to one standard error shocks. The gray bands are the 95 percent bootstrap confidence intervals. This figure displays all statistically significant impulse responses based on the vector error correction model, except the responses of the variables to their own shocks.

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