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HOUSEHOLDS' LABOR SUPPLY ELASTICITY

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This paper examines the influence of the family structure on the labor supply of husband and wife, using the formulation of a dynamic search model, assuming two types of family - modern and conservative. The conservative families follow the classical approach, where the family is a patriarchal institution, the head of the family is the husband who is the main breadwinner, while the wife is the secondary supporter. This approach is modeled by a Stackelberg Leader game where the wife's job-search decisions follow the already known outcomes of her husband's job-search strategy. The modern family is defined by a symmetric Nash strategic game. The husband and wife simultaneously decide upon their search policies given their anticipations about their partner's decision. The paper formulates a finite-horizon dynamic discrete choice model for the labor-supply decision of the household with separate utility functions for the husband and wife. These utility functions are identical for both types of family, leaving the type of game as the sole differentiator between them. The model's simulations show that this distinction has a significant influence on the couple's labor supply: the participation rate of conservative women is lower than the one of modern women, and correlates strongly and negatively with the husband's participation rate, a relation that is weak in modern families. The paper also contains a macro economic survey of the participation rates of women in Israel, based on the CBS labor force and income surveys. The increase of 20% in women's participation rate in the past thirty years was led by the group of married women aged 25-55 with children, whose participation rate climbed by more than 30%.

1. INTRODUCTION

Labor force participation rate (LFP) of women in Israel and in other countries has been increasing constantly in the last decades. In Israel, for instance, the LFP of women increased from 26.5% in 1955 to 49.1% in 2003, and in the US, from 33% in 1949 to 59.6% in 2003.

In labor economics literature, the increase in women's LFP is usually explained by the increase in women's offered wages. This motivates women to work and invest in their human capital, an investment which involves higher level of education and professional experience.

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According to the theory presented in this paper, the changes in the position of women in society and in the family are an important cause of the increase in women's LFP. The advance in the position of women, and their becoming equal to men in the household, is the cause for the increase in their labor supply. This, in turn, motivates them to invest in their human capital and increases their offered wage. Hence, the rise in wages is endogenous in the system, and is the outcome of the change rather than its cause.

The literature describes the husband as the main breadwinner, and the wife as a secondary supporter, who will join the labor force mainly when the husband's wage is insufficient or when he loses his job. Papers dealing with the labor supply of the husband assume that he belongs to the labor force, and focus on the reasons for his unemployment, while those dealing with the wife's labor supply treat her as responsible for the maintenance of the household and children, and try to explain her entry to the labor force. This approach has characterized the literature of labor economics from its beginning.

One of the first papers describing the labor supply of women in this way was Mincer (1962). In his paper the wife maximizes a utility function, with the husband's wage as an exogenous variable in this function. Therefore, when the husband's income decreases the wife will either enter the labor market if she is currently unemployed, or choose to work more hours. This approach will be termed the *conservative approach* for describing the labor supply of women. Even more recent research treats the wife as a secondary supporter. In an article by MaCurdy and Heckman (1980, 1982) a multi-period model of married women was estimated. The effect of shocks in the husband's wage on the wife's decision to join the labor force was analyzed, and a weak negative correlation was found between them. Other empirical research, such as Eckstein and Wolpin (1989), also describes the wife as a secondary supporter who reaches her decision according to the husband's wage. This empirical research claims that the phenomenon of increase in the LFP of women is caused by the rise in their human capital, which has a positive effect on their offered wages. Eckstein and Wolpin (1989), for instance, focus on the influence of work experience on wages. A similar description of women's labor supply can be found in Van der Klaauw (1996), who shows that utility from marriage decreases with the wife's wage and increases with the husband's wage.

Along with research modeling the labor supply of individuals, research modeling the household started to appear, addressing the household as one economic unit maximizing a unitary utility function. One of the first papers describing the household in that way was that by Burdett and Mortensen (1978). Their work deals with a search model for individuals, but its final part is a generalization of the model for married couples. The results are similar to the ones of an individual search, and the primary addition of the work is in revealing the cross influence of wage on the level of the search: an increase in the wage of the husband or the wife will decrease the search level of the spouse, by increasing the threshold wage. Another model based on a unitary utility function is presented in Becker's papers (1973, 1974), according to which the household consists of two individuals, with separate sets of preferences but with a unitary utility function.

The unitary utility approach disregards the individuality principle: the individual's set of preferences does not always match the spouse's preferences. Research that tried to validate the unitary utility approach usually rejected the limitations this approach imposes. For instance, Bourguignon, Browning, Chiappory and Lechene (1993) found that the distribution of income between the husband and wife influenced their consumption, in contradiction to

the assumption that income is a public good. Research by Kooreman and Kapteyn (1986) rejected the unitary utility approach as well.

It is possible to say that the above approach was abandoned in favor of the *collective approach* in which the household consists of two individuals maximizing separate utility functions dependent on the spouse's characteristics. Several studies modeled the household in that way, and the description of the interaction between the husband and wife varies from study to study. Some use bargaining models; other use game theory models. The work of Horney and McElory (1981) focuses on Nash's bargaining rule and examines the empiric results. Their prime conclusion is a rejection of the unitary utility approach. Leutold's model (1968) uses Nash's equilibrium to describe the way the husband and wife make decisions. In this work the labor supply of the husband and wife is determined simultaneously, so that each individual determines a strategy (labor supply) in order to maximize his or her utility, given the spouse's labor supply.

An additional approach based on the collective model will be presented here. It will assert that the woman is no longer a secondary supporter, and therefore her labor supply is not determined *given* the husband's labor supply, but *parallel* to it. Taking care of the household and children are tasks common to the husband and wife. This approach will be called the *modern approach*.

The thesis of this paper is that in the past most families behaved according to the conservative model, while currently more families behave according to the modern model. This is the explanation to the increase in the LFP of women and their willingness to invest in accumulation of their human capital.

The model assumes two types of family that exist simultaneously: conservative families and modern families. The description of the conservative families follows the conservative approach, where the family is a patriarchal institution in which the husband, is the main breadwinner, while the wife is the secondary supporter. The game between the husband and wife will have two stages: in the first stage, the husband will determine his labor supply, and in the second stage, the wife will determine her labor supply given the husband's wage. Since the labor supply of the husband is known to the wife when she reaches her decision, and under the assumption that income and leisure are normal goods, such families will tend to act according to the income completion rule, meaning, if the husband's income is low, the wife will join the labor force, and the equilibrium in the game will be Stackelberg Leader.

In the description of the modern family, the husband and the wife are treated as equal supporters. Therefore, their labor supply will be determined simultaneously; each one will decide on his or her labor supply given his or her expectations about the partner's labor supply, and the equilibrium in the game is according to Nash. The husband and wife reach a decision before they can be certain of their partner's wage in the next period. They cannot predict unexpected shocks, positive or negative, in their partner's wage. Therefore, a negative correlation between the husband's wage and the wife's labor supply will not be found.

Under different sets of parameters, the model is solved once for conservative family specifications, and once for the modern family specifications. From the simulations it is possible to see that the game between the couple has a significant influence on their labor supply (when similar utility functions and parameters are used). In particular, we see that the assumption that the wife in the conservative model knows her husband's labor supply when deciding upon her job-search policy causes her to search only if her husband is unemployed.

The assumption in the modern model, on the other hand, is that women do not know the employment status of their husbands when they decide on their job-search policy, and therefore will usually choose to search for a job. The different job-search policy causes the modern woman's labor supply to be higher than that of the conservative woman, and almost uncorrelated with her husband's, while the conservative woman's labor supply is strongly and negatively correlated with her husband's.

The first part of the paper describes the theoretical model; the second part gives a macro-economic survey of the LFP of women in Israel in the years 1970-2000, descriptive statistics of the data and an estimation of the model's reduced-form equations; the last part describes the model's simulations, i.e., a solution of the model for modern and conservative families under various sets of parameters.

2. THE MODEL

This section formulates a finite-horizon dynamic discrete-choice model for the labor supply decision of households. The household consists of a female and a male, each with his own utility function. The husband chooses between full-time employment (FE), unemployment (UN) and being out of the labor force (OLF), and the wife chooses between FE, part-time employment (PE), UN and OLF. On the day of the wedding each couple is exogenously assigned to one of the following family types: conservative and modern.

The conservative families follows the classical approach,[1] where the family is a patriarchal institution, the head of the family is the husband, who is the main breadwinner, while the wife is the secondary supporter. This approach is modeled here by a Stackelberg Leader game where the husband chooses first whether to search for a job. Then, after the outcomes of her husband's decision are known the wife chooses whether to search or not.

The modern family is defined by a symmetric Nash strategic game. The husband and wife simultaneously decide whether to search for jobs. Each one decides on his search policy, given his anticipations about his partner decision, and the equilibrium is according to Nash.

The husband (H) and wife (W) utility functions are identical for both types of family in order to emphasize the role of the game.

The husband and wife have different preferences with respect to leisure and consumption. In particular they differ in their risk aversion; wage and jobs offers expectancy, may also differ.

2.1 Specification

At each period *t*, starting on the wedding day and ending at retirement, the husband (wife) chooses an element *a* among his (her) choice set *A*, which contains three alternatives for the husband: full-time employment (*a=1*), unemployment (*a=2*), out of labor force (*a=3*); and four alternatives for the wife: part-time employment (*a=0*), full-time employment (*a=1*)unemployment (*a=2*), out of labor force (*a=3*).[2] The choice variable $d_{ij}^{a}(t)=1$ equals

[1] Mecurdy and Heckman (1982), Eckstein and Wolpin (1989), Van der Klaauw (1996).

[2] Part-time employment is possible only for the wives.

one if individual $j = H, W$ from household i chooses alternative a at time t, and zero otherwise. The three (four) alternatives are mutually exclusive, implying $\sum_{a=1}^{A} d_{ij}^{a}(t) = 1$ for every t. The periodic utility maximized by the husband and wife, U_{itj}, is assumed to be additive in consumption and labor-market states, such that

$$
\begin{aligned}
(1)\quad U_{itH} &= uc(N_{it}, C_{it}, L_{it}) \cdot d_{iH}^{1}(t) \\
&\quad + \left(uc(N_{it}, C_{it}, L_{it}) + \varphi_H (l_{iHt} - SC) + \varepsilon_{itH}^{2}\right) \cdot d_{iH}^{2}(t) \\
&\quad + \left(uc(N_{it}, C_{it}, L_{it}) + \varphi_H l_{iHt} + \varepsilon_{itH}^{3}\right) \cdot d_{iH}^{3}(t) \\
&\quad + F(C_{it}) \ ; \\
U_{itW} &= uc(N_{it}, C_{it}, L_{it}) + 0.5\varphi_W l_{iWt} \cdot \cdot d_{iW}^{0}(t) \\
&\quad + uc(N_{it}, C_{it}, L_{it}) \cdot d_{iW}^{1}(t) \\
&\quad + \left(uc(N_{it}, C_{it}, L_{it}) + \varphi_W (l_{iWt} - SC) + \varepsilon_{itW}^{2}\right) \cdot d_{iW}^{2}(t) \\
&\quad + \left(uc(N_{it}, C_{it}, L_{it}) + \varphi_W l_{iWt} + \varepsilon_{itW}^{3}\right) \cdot d_{iW}^{3}(t) \\
&\quad + F(C_{it}),
\end{aligned}
$$

where $uc(N_{it}, C_{it}, L_{it})$ is the household's children utility function.[3] N_{it} is the number of children, C_{it} is the household common consumption, SC is the search cost, l_{itj} is the individual leisure, and L_{it} is the household aggregative leisure. Leisure is defined as the time in which the individual does not work. I will normalize to one the sum of time an individual has, hence full-time employment leaves him with zero leisure, and part-time employment leaves him with a leisure value of 0.5. When searching for a job, the cost of the search is subtracted from his leisure.

The household budget constraint at each period t, $t=1,...,T$ is given by

$$
\begin{aligned}
(2)\quad & \left(w_{iHt} + y_{i-Ht}\right) \cdot d_{iH}^{1}(t) + \left(y_{i-Ht}\right) \cdot \left(d_{iH}^{2}(t) + d_{iH}^{3}(t)\right) = C_{it}^{4} \\
& \left(w_{iWt} + y_{i-Wt}\right) \cdot d_{iW}^{1}(t) + \left(wp_{iWt} + y_{i-Wt}\right) \cdot d_{iW}^{0}(t) + \left(y_{i-Wt}\right) \cdot \left(d_{iW}^{2}(t) + d_{iW}^{3}(t)\right) = C_{it}^{5} \ ,
\end{aligned}
$$

where w_{itj} is the individual's full-time wage, wp_{itj} is the individual's part-time wage and y_{i-jt} represents additional sources of income, such as the earnings of the spouse. Given the linearity of preferences, the periodic utility, U_{itj} can be written as

$$
(3)\quad U_{itj} = \sum_{a=1}^{A} u_{itj}^{a} d_{ij}^{a}(t),
$$

where u_{itj}^{a} is the periodic utility associated with choosing alternative a at time t. Substituting

[3] The children's utility is dependent on their number and ages, and is an increasing function of the sum of their parents' consumptions and leisure. Through the children's utility, a positive relation is created between the utility of one to the leisure of the spouse.

[4] From the husband's point of view.

[5] From the wife's point of view.

C_{it} obtained from (2) in (1), the alternative-state specific utilities at time *t* are:

$$
\begin{aligned}
(4)\quad u^1_{itj} &= F\left(w_{itj} + y_{it-j}\right) + uc\left(N_{it}, C_{it}, L_{it}\right) \\
u^2_{itj} &= F\left(y_{it-j}\right) + uc\left(N_{it}, C_{it}, L_{it}\right) + \varphi_j\left(l_{itj} - SC\right) + \varepsilon^2_{itj} \\
u^3_{itj} &= F\left(y_{it-j}\right) + uc\left(N_{it}, C_{it}, L_{it}\right) + \varphi_j \cdot l_{itj} + \varepsilon^3_{itj} \\
u^0_{itj} &= F\left(wp_{itW} + y_{it-W}\right) + uc\left(N_{it}, C_{it}, L_{it}\right) + 0.5\varphi_w \cdot l_{itW}
\end{aligned}
$$

where $\varepsilon^2_{itj}, \varepsilon^3_{itj}$ are the time-varying utility shocks which are assumed to be serially uncorrelated.

The stochastic offered wage follows a standard Mincerian wage function:[6]

$$(5)\quad w_{itj} = \exp\left(\alpha_{0j} + \alpha_{1j} \cdot ed_{itj} + \alpha_{2j} \cdot k_{it-1j} - \alpha_{3j}\left(k_{it-1j}\right)^2 + \varepsilon^1_{itj}\right),$$

where ed_{itj} denotes the individual years of schooling, k_{it-1j} is the actual work experience that the individual accumulated. The work-experience stocks evolve according to:

$$(6)\quad k_{itj} = k_{it-1j} + d^1_{ij}(t),$$

where the initial value of the endogenous experience is given by the experience on the day of the wedding. The individual's choices take into account the fact that future job opportunities and wage offers depend on the endogenously accumulated work experience.

ε^1_{itj} is a time-varying shock which is assumed to be serially uncorrelated. The random elements of the husband $\varepsilon_{itH} = \left[\varepsilon^1_{itH}, \varepsilon^2_{itH}, \varepsilon^3_{itH}\right]$ (of the wife $\varepsilon_{itW} = \left[\varepsilon^0_{itW}, \varepsilon^1_{itW}, \varepsilon^2_{itW}, \varepsilon^3_{itW}\right]$) are assumed to be sampled out of a joint normal serially independent distribution, such that, $\varepsilon_{itj} \sim iidN\left(0, \Omega\right)$, where Ω is not restricted.

The objective of the individual is, thus, to maximize

$$(7)\quad E\left[\sum_{T=1}^{T} \beta^t \sum_{a=1}^{A} u^a_{itj} d^a_{ij}(t) I^a_{itj} \left| s_{ij}(0)\right.\right]$$

by choosing a sequence of the control variable $d^a_{ij}(t)$ for all $t = 1,....,T$, where *t* is time since the wedding, *T* is the retirement period and β is the discount factor. I^a_{itj} is an indicator function that is equal to one if alternative *a* is available at time *t*. The expectation operator $E\left[\bullet \left| S_{ij}(0)\right.\right]$ is defined over the distribution of ε_{itj} and the probability of availability of a job offer is as defined below. $s_{ij}(0)$ is the individual's state space on the day of the wedding (*t=0*) which contains all the variables that are known to the individual at this period and affect either his current or future utility.

[6] In part-time employment: $wp_{itj} = \exp\left(\alpha^p_{0j} + \alpha^p_{1j} \cdot ed_{itj} + \alpha^p_{2j} \cdot k_{it-1j} - \alpha^p_{3j}\left(k_{it-1j}\right)^2 + \varepsilon^0_{itj}\right)$.

The availability of labor states at each date t in the optimization (7) is determined as follows. The individual can always choose to be OLF, such that $I^3_{itj} = 1$ for all t; in each period, the individual can receive at most one job offer.[7] The probability of receiving a job offer at time t depends on the labor-market activity that the individual engaged in during the previous period $d^a_{ij}(t-1)$, as well as on the individual's years of schooling and accumulated work experience. I adopt the following logistic form for the job offer probability,

$$(8) \qquad P^a_{itj} = \frac{\exp\left(\rho^a_{0j} + \rho_{1j} \cdot ed_{itj} + \rho_{2j} \cdot k_{itj}\right)}{1 + \exp\left(\rho^a_{0j} + \rho_{1j} \cdot ed_{itj} + \rho_{2j} \cdot k_{itj}\right)} .$$

Moreover, in each period an individual may loose his job with probability inversely related to his accumulated experience and education.

The optimization problem (7) can be represented by a set of alternative specific-value functions, each obeying the Bellman (1957) equation:

$$(9) \qquad V^a_{ij}\left(s_{ijt}, t\right) = u^a_{ij}(t) + \beta \cdot E\left(\max\left[V^a_{ij}\left(s_{ijt+1}, d^a_{ij}(t), t+1\right)\right] \mid s_{ijt}, d^a_{ij}(t) = 1\right)$$

$$V^a_{ij}\left(s_{ijT}, T\right) = u^a_{ij}(T)$$

where $V^a_{ij}\left(s_{ijt}, t\right)$ is the maximum expected present value if alternative a is chosen at time t, for a given element of the state space s_{ijt}. As seen in (9), future decision are assumed to be made optimally for any current choice a, $a \in A$.

Finally, under the above setting, the state space in period t can be written as,

$$(10) \quad s_{ijt} = [k_{iHt}, k_{iWt}, ed_{iHt}, ed_{iWt}, d_{iH}(t), d_{iW}(t), N_{it}] .$$

2.2 The influence of children on their parents' labor supply

Children have a significant influence on the labor supply of their parents. Their arrival in the household changes the priorities and customs in their parents' lives. Taking care of a child requires substantial time, and therefore changes time allocation between work and leisure, and hence, changes the labor supply of the couple. Household consumption also changes: children increase consumption but do not aid the household income, therefore budget constraints cannot be raised.

The main findings in the literature—Heckman and Macurdy (1980), Eckstein and Wolpin (1989), Hotz and Miller (1988)—show that the existence of children, especially young ones increases the value of leisure for the mother, and thus decrease her labor supply. This influence weakens and even reverses when the children grow up. As for the father, it seems that his labor supply is positively influenced by the existence of children. Another common finding is that the age of children affects their need for parents' leisure. On the other hand, household expenses are influenced by the number of children but not by their ages. The utility of a child will therefore be:

[7] The wife can get either a full-time-job offer or a part-time-job offer.

$$(11) \quad uc_{it} = (cl/cage_{it}) \cdot (L_{it}/N_{it}) + cc \cdot (C_{it}/N_{it}),$$

where *cage* is the age of the child, *cl* is the return from leisure, and *cc* is the return from consumption. Examining the child's utility function will show that for $cl, cc > 0$ this function increase with the parents' total leisure and consumption. Being indifferent to the specific amount of time each of the parents invests in the children will make the leisure of the husband's and wife's substitution goods. In the same way, we will assume that there is no importance to the source of the children consumption - only the total consumption allocated for them. This utility depends on two other factors: the child's age – the younger they are, the more care and attention time they need; and the number of children in the household – the more children there are in the house, the more leisure and income needed to keep the children at a certain level of utility. In order to allow for the influence of age on utility, the return from leisure *cl* was divided by the age of the child.

Since parents want to maximize their children's utility, the children utility function will be a part of the utility functions of the parents. The utility of each child will not be separate, but averaged in their parents' functions.

Since young children have greater utility from leisure, the parents of young children will find it more difficult to give up leisure. According to this, if an individual receives a low wage offer, he might reject the offer. Moreover, if the individual knows that his wage offers are sampled from a low expectancy wage distribution, he might avoid job searching and stay at home thus increasing utility from leisure, leaving the better-rewarded member to be provider of the children's consumption.

2.3 Conservative family

At the first stage the husband chooses weather to search for a job or not. At the second stage it is known whether the husband is FE, UN or OLF. The third stage is the wife's decision. The wife can choose whether to search for a job. The decision of the wife will lead her to one of four possibilities: FE, PE, UN or OLF. The equilibrium in the game will be Stackelberg Leader: the husband will decide upon his actions to maximize his expected utility, while the wife chooses the possibility that maximizes her utility given the outcomes of the husband's decision. The solution for this game will be recursive: first I will find the state that maximizes the utility of the wife in each possible state of the husband, and then the husband will choose the possibility that maximizes his utility, knowing what the reaction of the wife will be. Due to the couple's risk aversion and under the assumption that income and leisure are normal goods, such families will tend to act according to the income completion rule. Therefore a negative correlation will be created between their labor supplies.

2.4 Modern family

In the modern family the husband and wife make their decisions simultaneously. Each of them will calculate the expected utility for each of his or her partner's possible selections, and try to maximize it. The equilibrium in this game will be according to Nash. Since neither of them knows for certain what the spouse's labor force status will be in the next period,

the relation between their labor supplies will be weaker than in the conservative family. The insurance factor, which played a major role in the search decision of the couple in the conservative family, will be a minor factor in the modern family. Individuals in this family do not know the outcome of their partner's search, and therefore cannot adjust their search policy to it.

3. DATA

In this chapter there are three parts. The first is a macroeconomic survey of the LFP of women in Israel in the past thirty years. The second describes the data that were used for the model's estimation; and the third is dedicated to a non-structural estimation of the model's equations (reduced from).

a. Women's participation in the Israeli labor force—a macroeconomic survey

The increase in the LFP of women in the past century is one of the most important developments in labor economics. This rate has increased in Israel, as in other countries, very rapidly . According to the earliest data that we have, it increased from 26.5% in 1955, to 49.1% in 2003. In addition to the change in LFP, the rate of women working in full-time as opposed to part-time jobs has increased, as well as the average weekly working hours. All of the above are clear indications of the increase in women's labor supply.

The diagram in appendix 1 describing the evolution of LFP, shows that the change in the years 1955-1970 was relatively minor (less than 3% in these 15 years). On the other hand, the next three decades were characterized by a steep increase of 6 to 7 percent per decade. Therefore, the following survey will focus[8] on the years 1970 – 2000.

Table 1 shows that together with the increase in the LFP of women, there was a decrease in the LFP of men. In Israel's first 30 years this rate declined significantly, while in the past 23 years the rate stabilized at 60% (even though minor decreases in the rate continue to occur).

Table 1
LFP of men and women

(percent)

	Male	Female
1960	78.1	27.3
1970	69.2	29.3
1980	63.7	35.7
1990	62.3	41.1
2000	60.8	48.2

The labor force consists of individuals with full-time jobs, part-time jobs, and unemployed. Table 2 present the trends in the distribution of women among these states. It is seen that the rate of unemployment which was low in the 1970s and 1980s, increased significantly during the 1990s (due to the large immigration wave from the former Soviet Union). Then the rate of unemployment decreased in the mid 1990s, and rising again because of a long-lasting recession. In the 1970s, most of the employed women worked full-time, while in the years 1980 and 1990 about half of the employed women worked part-time. In the last decade there was a noticeable return

[8] Another reason for that focus is the availability and reliability of the data. Central Bureau of Statistics (CBS) Labor Force surveys, on which this survey is based, have been held regularly since 1967.

Table 2
Distribution of women by employment status

	1970		1980		1990		2000	
	All	Jewish	All	Jewish	All	Jew	All	Jewish
Employed	95.2	95.2	94.4	94.2	88.7	88.5	90.8	91.0
Full-time	57.9	57.7	44.5	43.5	40.6	39.9	48.3	48.3
Part-time	30.4	30.5	40.5	41.3	39.7	40.1	34.8	35.0
Absent	6.9	7.0	9.4	9.4	8.4	8.5	7.8	7.8
Unemployed	4.8	4.8	5.6	5.8	11.3	11.5	9.2	9.0

to working in full-time jobs. For instance, in the year 2000, more than 65% of the employed women were in full-time employment.

Since this paper deals with the labor supply of married Jewish women, we shall focus on that group from now on. The LFP of women of that group has increased by more than 30% since 1970. So, it is possible to say that this group leads the growth in the LFP of women in Israel. Therefore, if we find the reasons for the increase of the LFP of married women, we shall understand the reasons for the increase in the LFP of women in general.

Table 3 describes the LFP of women according to marital status. It is seen that divorced women have a constant LFP of about 60%, which is the highest LFP – probably because most of them are mothers and prime supporters. The LFP of widowed women decreases through time, due to the expansion of life expectancy in Israel. The group of single women showed a moderate increase in the LFP, about 10% during past 30 years.

Table 3
LFP according to marital status

	1970		1980		1990		2000	
Martial Status	All	Jewish	All	Jewish	All	Jewish	All	Jewish
Married	26.8	29.7	38.6	42.9	47.3	53.7	55.6	63.0
Divorced	63.0	63.7	55.0	58.0	62.7	64.7	62.9	64.1
Widowed	17.4	18.7	14.4	15.5	14.9	16.1	12.0	12.6
Single	38.3	41.3	32.6	36.2	34.9	39.3	43.7	48.0

Children are another factor known to have a strong influence on women's LFP.

As seen from Table 4, the existence of children in the household significantly increases the LFP of women. Mothers of children increased their LFP by 45% (!) in the past 30 years. Nevertheless, one should recall that the number of children under 14 years old is correlated with other factors that influence LFP, such as age and marital status. It is evident that the *number* of children in the household is negatively correlated with the woman's LFP. Indeed, the difference in LFP between a mother of one child and a mother of two is relatively small, and so does the difference between a mother of two and a mother of three children. But, the mother in a family with four children will have a significantly lower rate.

Table 4
LFP of non-single Jewish women according to number of children (aged 0–14)

Number of Children	1970	1980	1990	2000
No children	29.6	29.9	33.3	41.5
With children	28.0	48.5	63.3	74.6
1 child	37.3	53.0	66.5	76.9
2 children	29.2	52.6	66.7	80.6
3 children	20.0	44.4	62.6	71.9
4 children and more	12.8	27.5	43.6	51.4

Tables 1–4 reflect the most significant factors on the growth in LFP in Israel. The steepest increase rate was in the group of married women, mothers of children. Hence, from now on we shall focus on that group of women, and the reasons motivating them to join the labor force.

b. Descriptive statistics

The sample is based upon two surveys made by the Central Bureau of Statistics – labor force survey and income survey. Both were performed in the years 1993 and 1994. Non Jewish and non married individuals were removed from the data file, as well as couples for whom there were no data on both husband and wife. Since the research deals with questions related to labor supply, individuals older than 65 were removed from the file too. After these rearrangements, 755 families (couples) were left in the sample.

This labor force survey contains personal data on the individuals' ages, education, place of birth, number and ages of children, etc. In addition, the survey includes data on their employment status – full-time and part-time jobs, unemployment, non-participation in the labor force, occupation, working hours etc. The income survey adds data on the couple's income from wage and other resources, and on the total income of the household.

Table 5
Descriptive statistics of the model's variables

		Obs.	Mean	Std err.	Min	Max
Male	Years of schooling	2,996	13.14	3.48	2.00	25.00
	Age	3,000	44.88	10.05	26.00	65.00
	Wage per hour	371	29.28	15.67	4.17	87.95
	Weekly working hours	2478	49.41	11.70	8.00	98.00
Female	Years of schooling	2,981	12.93	2.99	2.00	26.00
	Age	2,972	41.81	9.48	25.00	65.00
	Wage per hour	314	23.74	12.09	2.95	78.52
	Weekly working hours	1681	34.36	10.99	6.00	87.00
	Children	3,020	1.63	1.41	0.00	9.00

Wage per hour in NIS at December 1994 prices

For every couple in the file there are four observations. In a period of a year and a half, there are two observations in successive quarters, then a pause of 6 months and again two additional observations in quarters. Wage data exist only for the fourth observation.[9] We have a total of 3,020 observations in the file, four for each of the 755 couples. Table 5 shows descriptive statistics of the sample. The LFP of women in the sample (67%) is higher than the LFP of women in the population (44.7% in 1994). There are two reasons for this: first, the women in the sample are married, which increases their LFP (the LFP of married women in 1994 was 51.4%); the second reason is the distribution of age in the sample – about 60% of the women in the sample are aged 35 – 54, ages that are characterized with above average LFP. The LFP of men in the sample is very high as well: 90.5%, compared with 62.8% in the population – for the same reasons.

Table 6 shows the LFP of men and women in the sample by age groups and years of schooling.

Table 6
LFP by age, gender, and years of schooling (percent)

		Female LFP	Male LFP
By age	18–24	39.6	20.0
	25–34	67.6	87.0
	35–44	69.0	92.4
	45–54	75.7	96.9
	55–64	46.7	85.3
By years of schooling	0–4	25.5	64.7
	5–8	36.5	85.8
	9–12	61.5	92.1
	13+	80.1	90.3

Table 6 shows that the LFP of women increases sharply with years of schooling. As for men, LFP is not related to years of schooling.[10]

LFP as a function of age is non-monotonic. It increases until the age of 45-54, but then drops in the next age group (55 – 64). The decrease applies both to men and women, but it is more acute for women.

For individuals in the labor force we shall check the division between employment and unemployment, as well as the different levels of employment. “Unemployed” will be a person who is not working but has looked for a job in the past week, while “out of labor force” will be a person who is not working and has not looked for work in the past week. Table 7 shows the distribution of men and women by employment status.

Unemployment rates in the sample are lower than the rates in the population. For the men in the sample, it is less than 3%, while in the population this rate is 6.2%. This result is due to the lack of non-Jewish unmarried individuals in the sample. The unemployment rate of women is also less than that of the population, for similar reasons.

[9] Income and LF surveys contain data on the same individuals, therefore their merging gives us a more complete view.

[10] Except for a small group of men with 0 – 4 years of schooling (less than 2% of the men in the sample).

Table 7
Distribution of employment status by gender

	Employed[1]		Unemployed
Male	97.5%		2.5%
	Full-time	Part-time	
Female	53.9%	38.8%	7.3%

[1] Since only 3.15% of the men in the sample have a part-time job, such employment status for men was not defined.
[2] A part-time job is defined as a job of less than 30 hours per week.

We shall look at the changes of the employment status distribution over time. According to Table 8, the distribution in the sample hardly changes, except for a decrease in the unemployment rate which resulted from the general decrease in the unemployment rate in the years 1993–1994. Generally speaking, we should not expect far-reaching changes in LFP in such a short period, in which no major macroeconomic or personal changes occurred.

Table 8
Distribution of men and women by employment status (percent)

	Female				Male		
Quarter	FE	PE	UN	LFP	FE	UN	LFP
1	51.2	39.6	9.3	67.3	96.2	3.8	90.2
2	51.9	41.2	7.0	66.6	96.8	3.2	90.6
3	56.8	36.3	6.9	67.2	98.5	1.5	89.9
4	55.6	38.3	6.1	67.4	98.4	1.6	91.1

It will be more interesting to examine changes in the employment state of individuals, namely, state transitions along the sample period. We will therefore present transition matrices from one employment state to another.

Table 9
Employment state transitions of women

	4th Quarter				
1st Quarter	FE	PE	UN	OLF	Obs.
Full-time	78.9%	14.2%	3.1%	3.6%	260
Part-time	27.4%	59.7%	2.5%	10.5%	201
Unemployed	23.4%	17.0%	8.5%	51.1%	47
Nonparticipation	4.5%	11.7%	5.7%	78.1%	247

Table 9 presents employment state transitions of the women in the sample. It is evident that even though the ratio of individuals in each state hardly changes through time, there are many changes in the individuals' states during a year and a half. It is interesting to see that only 8.5% of the women that were unemployed in the first quarter remained unemployed until the fourth quarter (throughout the whole 1.5 years). This shows that a large percent of the unemployed women (40.4%) managed to get out of the circle of unemployment; and even

Table 10
Employment state transitions of men

	4th Quarter			
1st Quarter	Employment	Unemployment	OLF	Obs
Employment	97.6%	1.2%	1.5%	655
Unemployment	84.6%	3.9%	11.5%	26
Nonparticipation	24.3%	2.7%	73.0%	74

more women (51.1%) chose to leave the labor force. The perseverance rate in a full-time job is high, close to 80%, and so is the perseverance rate of women who are not in the labor force. On the other hand, the perseverance rate of women who work in a part-time job is lower (60%) and 27% of them started to work in a full-time job during the sample period.

Table 10 presents the transitions matrix for men. Leaving the circle of unemployment for men is quite common. Only 4% of the men that were unemployed in the first quarter remained unemployed throughout the sample period. Unlike unemployed women, most unemployed men (85%) start to work, and only 11.5% of them leave the labor force. Work perseverance is very high (98%), while 24% of the men that were out of the labor force in the beginning of the period chose to join the labor force during the period.

(1) The influence of the number and ages of children on the couple's labor supply
26% of the couples in the sample do not have children aged 0 – 17. The majority of them were older individuals whose children were over 17, but for half of them (12%) the children still lived in the household. Only a small percentage did not have any children. 25% of the couples had one child under 17, 45% had two to four children, and the remaining 3% had five children or more. It seems that the LFP of men and women decreases with the increase in the number of children. The most dramatic change is between families with four children and families with five children (a decrease of 20% for women and 15% for men). It is also seen that the LFP of couples without children aged 0 – 17, is *lower* than the LFP of couples with children in these ages; this is, however, because of the high rate of older individuals (with children over 17) in this group. The distribution of the number of children in the sample, and the influence of this number on the LFP of men and women, is shown in Table 11.

Table 11
LFP of men and women by number of children

Number of children aged 0–17 years	Number of families	Percentage of families	Women's LFP	Men's LFP
0	200	26.5%	63.0%	87.5%
1	193	25.6%	77.2%	93.3%
2	167	22.1%	74.3%	92.8%
3	133	17.6%	63.9%	97.0%
4	39	5.2%	51.3%	84.6%
5+	23	3.0%	21.7%	69.6%

A linear regression that estimated the influence of the number of children on the amount of weekly working hours showed a decrease of three hours for men and four hours for women for every additional child (Table 18).

(2) The relation between the labor supply of the husband and wife

A weak positive correlation exists between the man's employment status and the woman's status. The distribution of employment states for women with working husbands is similar to the distribution for women in the whole sample. Women with unemployed husbands had an unemployment rate of 13% (compared to 7.3% in the whole sample), and women with husbands who were out of the labor force had an LFP of 44.8% (20% less than the whole of the sample). This difference does not necessarily stem from the couples' choices, but from a strong positive correlation between their personal characteristics, such as age and education. Data on the distribution of the employment states and LFP of men and women are presented in Table 12.

Table 12
Distribution of the employment state of women by the men's employment status

	Wife's status			
Husband's status	Employed full-time	Employed part-time	Unemployed	OLF
Employed	54.0%	38.9%	7.1%	69.6%
Unemployed	43.5%	43.5%	13.0%	66.7%
OLF	55.8%	36.4%	6.1%	44.8%

Table 13 presents the average wage of men according to the employment states of their wives. The data in the table do not indicate a clear relation between the wife's labor supply and the husband's wage: on one hand the wage of men with wives who work full-time is lower than the wage of men with wives who work part-time (an indication that there is a negative correlation); on the other hand, the wage of men with wives out of the labor force is lower than the wage of men with wives who work in part-time jobs (an indication of a positive correlation between them).

Table 13
Average wage of men by the employment status of their wives

Wife's status	Employed full-time	Employed part-time	Unemployed	OLF
Husband's average wage	6,369.8	7,228.7	4,541.5	5,628.4

Wage per month in NIS at December 1994 prices

c. Non-structural estimation of the model's equations (reduced form)

(1) Experience and education influence on wages

In the model presented in the previous chapter, as well as in the literature, it is assumed that the wage is influenced by the seniority in the labor market (experience), and by education. In

order to examine this assumption, two separate linear regressions, for men and women, were performed on the LOG of the wage per hour. Education is measured by years of schooling, and in order to check experience we shall build an instrumental variable based upon age and education. The experience of individuals is calculated as the difference between their age and years of schooling. Military service was subtracted from that and so were six (pre-school) years. Therefore, this variable reflects the individual's potential experience rather than actual experience. It is commonly accepted that the return for experience is decreasing; therefore the square of experience was added to the wage regression. The return for schooling was 7% per year for men and 8% per year for women. Moreover, the return for experience was 2.5% for women and 2.2% for a man, with the return decreasing with experience. All regression coefficients were significant.

Estimators for the above wage equation are biased estimators for the offered wage in the market, because they are received from estimation of the observed wage, while unaccepted wage offers are not observed. In order to correct the bias we shall use Heckman's correction (Heckman 1974). The corrected wage regressions are presented in Table 15.

Table 14
Log linear wage regression

Variable	Husband	Wife
Constant	3.416	3.012
	(0.206)	(0.204)
Years of education	0.073	0.083
	(0.009)	(0.011)
Experience	0.022	0.0251
	(0.012)	(0.012)
Experience 2	–0.0002	–0.0001
	(0.000)	(0.000)
Obs.	380	320
R^2	0.1414	0.1663

As a result of the correction in the women's regression, the estimators changed from 8% per year of schooling to 6%, with the experience estimator decreasing as well – but more moderately. In the men's wage regression, the major change was in the return for experience, which became insignificant. After the correction the result was that the return for education was about 6% both for men and for women, and that the return for experience was 2% for women and insignificant for men.

Table 15
Log linear wage regression using Heckman's correction model

Variable	Husband	Wife
Constant	3.850	3.493
	(0.233)	(0.296)
Years of education	0.066	0.062
	(0.010)	(0.015)
Experience	0.008	0.024
	(0.013)	(0.014)
Experience 2	0.00006	–0.003
	(0.000)	(0.000)
Obs.	568	445
Likelihood	–647.240	–479.198

In order to fully describe the women's wage function, the difference between the wages of a full-time job and of a part-time job wage should be examined. This is done through two separate regressions, one for women working full-time and the other for those working part-time. The wage regression specification remained intact. The equations were estimated using Heckman's correction model. Results are presented in Table 16.

The average wage per hour for women working full-time was NIS 24.6, and for women working part-time it was NIS 25.2– a minor difference. Nevertheless, the standard deviation of the wage for

Table 16
Women's Log linear wage regression using Heckman's correction model

Variable	Wage per hour full-time job	Wage per hour part-time job
Constant	3.045	3.512
	(0.368)	(0.931)
Years of education	0.072	0.111
	(0.017)	(0.027)
Experience	0.025	0.005
	(0.016)	(0.036)
Experience 2	–0.0004	0.0002
	(0.000)	(0.001)
Obs.	445	445
Likelihood	–411.520	–293.664

full-time job was much larger than for a part-time job (24.5 and 13.7 respectively). The regression estimation shows that the return for schooling in a part-time job is 11% - higher than the 7% return for schooling of a full-time job. The return for experience showed the opposite: women working full-time had 2.5% return per year of experience; while women working part-time had an insignificant return for experience.

(2) Examination of the individual's LFP decision via LOGIT model

In order to examine the factors influencing a woman's decision to participate in the labor force, a LOGIT model was estimated. This LFP decision, as described in the model, depended on her husband's wage, his weekly working hours (when he is unemployed or out of the labor force, the value of his wage and weekly hours is zero), as well as the woman's characteristics: years of schooling, age and number of children.

As can be seen from Table 17, the husband's characteristics have no influence on the wife's LFP decision: the coefficients of the man's wage and working hours are small and insignificant. The wife's characteristics parameters resulted as expected: years of schooling had a positive influence on the wife's LFP decision; age influence was also a positive, though decreasing with time, and number of children had a negative influence.

We derive from the LOGIT results that there is no relation between the husband's wage and labor supply, and the wife's LFP decision. Even a more detailed examination of this relation had similar results: the estimators of a multinomial LOGIT model to the wife's employment status (FE, PE, UN and OLF) point to the same influences as in the LOGIT model regarding the explanatory variables of the wife's characteristics, while the husband's labor supply characteristics are insignificant (Appendix 2). From the above we may derive that there is no correlation between the characteristics of the husband's labor supply and the wife's LFP decision. We also used a linear regression in which the dependent variable is the wife's weekly working hours and the explanatory variables are identical to the ones used in the LOGIT model. The results of this regression also show that the husband's working hours and wage does not influence the wife's working hours, and the influence of the personal characteristics of the wife are as in the LOGIT model. The estimation results are presented in Table 18.

Table 17
LOGIT model for the LFP of men and women

Variable	Husband's LFP	Wife's LFP
Constant	1.800	–1.233
	(1.100)	(0.932)
Spouse's wage per hour	0.024	0.003
	(0.021)	(0.006)
Spouse's weekly work hours	–0.001	0.004
	(0.015)	(0.006)
Number of children 0–17	–0.250	–0.452
	(0.112)	(0.095)
Years of schooling	–0.052	0.145
	(0.048)	(0.048)
Experience	0.238	0.140
	(0.045)	(0.048)
Experience^2	–0.006	–0.004
	(0.001)	(0.001)
Obs.	561	445
Likelihood	–140.968	–242.229

Since our model includes the cross influences of the partner's labor supplies, all of the above estimations were also performed on the husbands in the sample. The results for the two estimations are similar in many ways: the working hours and wage of the wife had no influence on the husband's LFP decision, or on his working hours. The personal characteristics have a similar, but not identical influence. As in the women's case: age has a positive decreasing influence on the LFP and working hours; the number of children has a negative influence both on LFP and on working hours; unlike for women, years of schooling has a negative, though insignificant, influence. The estimation results are presented in Tables 17 and 18.

Allegedly, The data analysis presented above asserts that there is no connection between the husband's and wife's labor supply; such analysis demolishes the basic principle of family economics, which says that the decisions of the husband and wife are inter dependent, whether they maximize a unitary utility function or separate utility functions. The model described in the pervious chapter assumed that there are two types of

Table 18
Weekly working hour regressions for men and women

Variable	Husbands	Wives
Constant	–0.400	–28.259
	(14.948)	(15.561)
Spouse's wage per hour	0.000	0.000
	(0.000)	(0.000)
Spouse's weekly work hours	0.005	0.031
	(0.055)	(0.047)
Number of children agd 0–17	–3.104	–3.900
	(0.599)	(0.656)
Years of schooling	–0.447	1.103
	(0.206)	(0.284)
Experience	4.304	2.430
	(0.661)	(0.740)
Experience^2	–0.052	–0.033
	(0.007)	(0.009)
Obs.	546	443
R^2	0.148	0.166

family, characterized by different ways of employment decision making. The conservative family was characterized by a negative correlation between the husband's wage and the wife's labor supply, and with a lower labor supply for women. The modern family was characterized by a weak negative correlation between the husband's and wife's labor supply and with a higher labor supply for women.

In the presented model the type of family is unknown to the researcher (Unobserved Heterogeneity), but in order to analyze the data we shall assume there are some variables that are correlated with the type of family – education, origin etc. After the estimation of the complete model presented in the previous chapter, it will be possible to check if such correlation really exists (Eckstein and Wolpin 1999).

(3) Education

Let's assume that the husband's and wife's education is correlated with the family type – families in which the husband and wife are less educated will tend to act according to the conservative family rule. Families with higher level of education will tend to act according to the modern family rules. A well-known finding in the literature (also expressed in Table 6) is that the LFP increases with years of schooling, regardless of marital status. In the following analysis we shall examine whether the husband's education has influence on the wife's LFP (beyond the influence of her own education). Since there is a high correlation (57%) between the husband's and wife's years of schooling, this relation is difficult to check; in order to cancel the correlation effect, we shall check the relation between these two variables for a constant education level of the wife.

The LOGIT model (Table 17) shall be estimated twice: once for women married to men with less than 12 years of schooling, and once for women whose husbands have more than 12 years of schooling. Two interesting result are obtained from this estimation (the complete results are presented in Appendix 3). The first is the husband's wage coefficient. Women whose husbands had less than 12 years of schooling had a negative, though not significant, estimator, in contrast to the positive estimator in the full sample. Women married to men with more than 12 years of schooling had small, positive and insignificant estimators. This result is interesting because it strengthens the assumption that in a conservative family, a decrease in the husband's wage will cause an increase in the wife's labor supply. The second interesting result is that, given a constant level of education, the LFP of those women married to men of the less educated group is lower than the LFP of the women married to the more educated men. In order to demonstrate this visually, I have simulated the LFP of women as a function of their years of schooling (other explanatory variables received their average values). The simulation (Appendix 4) was preformed once for the set of women with educated husbands, and once for the complementary set. The simulation's results shows that women with less educated husbands will participate less in the labor force, regardless of their years of schooling.

Beyond the influence of wage, it is interesting to look at the correlation between the husband's and wife's working hours. For couples in which the husband has more than 12 years of schooling the correlation was 0.216, a much higher than that of the couples in which the husband had less than 12 years of schooling (0.048). This result may point to a complementary relation between the working (or leisure) hours of the husband and wife in a modern family, a relation that does not exist in the conservative family.

(4) Age

Additional analysis was performed according to the husband's age. We assumed that the rate of conservative families among elder couples is higher, and therefore we expected a negative relation between the labor supply of the husband and wife in these families. The LOGIT model was estimated again twice according to the husband's age. For couples in which the husband's age is more than fifty a significant negative correlation was found between the husband's and wife's labor supply, while for couples in which the husband's age was less than fifty a significant positive correlation was found.

(5) Years of marriage

Like age, long years of marriage should indicate a larger rate of conservative families. This also emerged from the model. For couples married prior to 1970 a negative correlation was found between the husband's and wife's labor supplies, while for couples married after 1970 a positive correlation was found.

To summarize: the initial result asserting there is no relation between the labor supplies of the husband and wife may be refuted. This relation exists, but varies in strength and direction between different groups of the population. These results match the theory presented in the previous chapter.

4. QUANTITATIVE ANALYSIS OF THE MODEL – SIMULATIONS

The following chapter will present a two-period model—a simplification of the multi-periodical dynamic model presented before; it will be used to examine the above theory more deeply. For the quantitative analysis of the model we shall assign each of the 14 parameters a certain value. We will calculate the utility of each individual in the family (Equation 12) for each of his or her possibilities (searching for a job or leaving the labor force). This calculation will be carried out for the husband and wife, using Stakelberg leader equilibrium and Nash equilibrium. The outcomes of the calculation will indicate the search policy of the husband in each type of family, revealing the LFP of the individuals as predicted by the model. From the simulations, presented below, it is seen that even for the two-period model, differences in the labor supplies of a modern and a conservative family appear.

In this model we will assume that the wage level of the individuals is constant and known to them–an assumption that simplifies the individual's decision. When the wage is unknown, the individual takes two decisions: the first is whether to search for a job; if this was the decision he or she took, and a job offer was received, the individual must decide whether to accept the offer or not. The second decision depended mainly on the offered wage. The assumption that the wage is pre-known cancels the need for the second decision. Under such assumption the individual can calculate the utility of searching and of not searching, and search for job only if the first is higher. In that case, if the individual searched for a job and received an offer, he or she will certainly take it. The constant wage level expresses the individual's value in the market. This level is constant for all individuals of the same gender, but different between men and women. Individuals in the model choose whether to search or not in order to maximize the discounted value of their utility. In the first period the husband

chooses to search or not to search for a job – thus, in the second period he might be in one of three states: FE, UN, and OLE. The wife in the first period chooses whether to search for a full-time job, a part-time job or not to search.[11] Therefore, in the second period the wife will be in one of four states: FE, PE, UN, and OLF. The husband and wife each maximize a two period value function of the form:

$$(11)\quad V_{iH} = \underset{\{S,\ US\}}{MAX}\left[U_{iH1} + \beta \cdot E\left(U_{iH2}\right)\right]$$

$$V_{iW} = \underset{\{SF,\ SP,\ US\}}{MAX}\left[U_{iW1} + \beta \cdot E\left(U_{iW2}\right)\right]$$

where U_{iH1}, U_{iW2} are the utilities of the husband and wife, respectively, in period *t,* and β is the discount factor. The simulations were performed by assigning various sets of numerical values to the model's parameters, and solving the model for these parameters. For each of these sets the model was solved twice–once for a modern family and once for a conservative family. In simulations a specific utility functions should be used. This function preserves the basic assumptions of the model

$$(12)\quad u_{ijt} = u_{ijt}\,[l_{ijt},\, C_{it},\, uc(N_{it},\, C_{it},\, L_{it})] = \varphi_j \cdot l_{itj} + C_{it} - \Phi C_{it}^{2} + uc(N_{it},\, C_{it},\, L_{it})$$

where C_{it} is common consumption, l_{itj} is the individual's leisure, φ is the return from leisure, Φ is the risk aversion coefficient; and $uc(N_{it},\, C_{it},\, L_{it})$ the average utility of a child in the family (see eq. 11). In the model there are 14 different parameters that determine the behavior of the individuals, as following:

p^w	Full-time job offer probability - woman	0.5
p^{wp}	Part-time job offer probability - woman	0.5
p^h	Full-time job offer probability – man	0.7
w^w	Offered wage – woman	24
w^h	Offered wage – man	30
wp^w	Part-time job offered wage – woman	12
Y	Non-labor income	14
ϕ	Income insurance component (risk averse coeff.)	0.007
φ	Return from leisure	11

[11] In the model it is impossible to search for a full-time job and a part-time job simultaneously.

Sc	Search cost	2
N	Number of children in the household	2
Cl	Children's utility from their parents' leisure	6
Cc	Children's utility from consumption	3
β	Discount factor	0.99

In every simulation 13 of the parameters were held with the above values, while the 14th parameter ranges in its specified interval. These values are unknown, and are therefore taken to be as close as possible to their assumed values. The job offer probabilities were taken from quarterly transition matrices.[12] The full-time job wage and non-labor income were set to be the sample's averages,[13] when the part-time job wage is half the full-time job wage according to the model's specifications. The values of: ϕ, φ, *c*, *cl* and search cost were assigned to be proportional to the values of the other parameters.[14] The number of children was set to be the average (rounded upwards), and the discount factor was taken, as accepted in the literature, to be 0.99.

Simulation 1 – The Influence of the Job Offer Probability on the Couple's Search Policy

There are three types of job offer probability in the model: men's job-offer probability; women's job-offer probability for a full-time job; and women's job-offer probability for a part-time job. The probabilities are notated accordingly: p^{wp}, p^{w}, p^{h}.

*An increase in the husband's probability to receive a job offer increases his probability to participate in the labor force and decrease that probability for his wife***.** For very low job-offer probabilities, the husband would prefer to be OLF; once this probability rises, husbands–both in modern and conservative families–would prefer to search for a job. The probability of

[12] For the population of men these matrices were calculated from the model's data. The calculation was performed quarterly, similar to the calculation performed for Tables 9 and 10. Out of these matrices, the average probability for transition from unemployment and non-participation to employment was taken. This value was rounded up so the probability of receiving a job offer is higher than the actual transition probabilities – this is because some of the job offers are rejected. As for the population of women, the states of not receiving a job offer and rejecting a job offer were inseparable, due to the fact that half of the women move from unemployment state to out of labor force state. Therefore, the probabilities of women were set to 0.5.

[13] Average wage per hour, see Table 5.

[14] The income insurance component is set in a manner that the consumption utility function will decrease only for values that are higher than the maximal income in the data. The leisure value is determined to be a little lower than the part-time job search in order to create unemployment patterns.

Simulation 1a
Husband's job offer probability

Conservative family							Modern family							
Wife's distribution				Husband's distribution			Wife's distribution				Husband's distribution			
OLF	UN	PE	FE	OLF	UN	FE	OLF	UN	PE	FE	OLF	UN	FE	p^h
0	0.5	0	0.5	1	0	0	0	0.5	0	0.5	1	0	0	0.0
0	0.5	0	0.5	1	0	0	0	0.5	0	0.5	1	0	0	0.1
0	0.5	0	0.5	1	0	0	0	0.5	0	0.5	0	0.8	0.2	0.2
0.3	0.35	0	0.35	0	0.7	0.3	0	0.5	0	0.5	0	0.7	0.3	0.3
0.4	0.3	0	0.3	0	0.6	0.4	0	0.5	0	0.5	0	0.6	0.4	0.4
0.5	0.25	0	0.25	0	0.5	0.5	0	0.5	0	0.5	0	0.5	0.5	0.5
0.6	0.2	0	0.2	0	0.4	0.6	0	0.5	0	0.5	0	0.4	0.6	0.6
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	0.7
0.8	0.1	0	0.1	0	0.2	0.8	0	0.5	0	0.5	0	0.2	0.8	0.8
0.9	0.05	0	0.05	0	0.1	0.9	0	0.5	0	0.5	0	0.1	0.9	0.9
1	0	0	0	0	0	1.0	1	0	0	0	0	0	1.0	1.0

being employed will therefore increase together with the probability to receive a job offer. The labor supply of men in both families is almost the same. However, there is a major difference between modern and conservative women's labor supply. It is evident that the modern wife chooses to search for a job under most circumstances, while the conservative takes the opposite choice of leaving the labor force. A conservative wife will search for a job only if her husband is not working, namely UN or OLF. For each case in which the husband is employed the conservative wife will choose not to search for a job. Since the conservative wife's search policy is determined only after the husband's search results are known, such a woman knows her husband's employment status and reacts accordingly. On the other hand, the modern woman does not know what the results of the search policy of the husband are, and therefore always chooses to search for job. The results of this simulation points to two substantial differences between modern and conservative families. The first difference is in the search level of the two types of women: the modern woman is characterized with a search level higher than the conservative woman's level. The second difference is in the relation between the labor supplies of the husband and wife: in a conservative family the relation is negative, while in the modern family there is no evidence for such a relation.

An increase in the probability of receiving a full-time job offer has a positive influence on the wife's search policy. Husbands, both in modern and conservative families, choose to search for a job regardless of the wife's probability of a job offer. Women in both families choose to search for a part-time job when the probability to find a full-time job is low. When this probability increases women tend to search for a full-time job. Here too, it is seen that the modern woman's labor supply is higher than that of a conservative woman. While the modern woman will always search for a job, the conservative woman will do so only if the

Simulation 1b
Wife's full-time job offer probability

Conservative family							Modern family							
Wife's distribution				Husband's distribution			Wife's distribution				Husband's distribution			
OLF	UN	PE	FE	OLF	UN	FE	OLF	UN	PE	FE	OLF	UN	FE	p^h
0.7	0.15	0.15	0	0	0.3	0.7	0	0.5	0.5	0	0	0.3	0.7	0.0–0.2
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0.5	0	0	0.3	0.7	0.3
0.7	0.15	0	0.15	0	0.3	0.7	0	0.6	0	0.4	0	0.3	0.7	0.4
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	0.5
0	0.4	0	0.6	0	0.3	0.7	0	0.4	0	0.6	0	0.3	0.7	0.6
0	0.3	0	0.7	0	0.3	0.7	0	0.3	0	0.7	0	0.3	0.7	0.7
0	0.2	0	0.8	0	0.3	0.7	0	0.2	0	0.8	0	0.3	0.7	0.8
0	0.1	0	0.9	0	0.3	0.7	0	0.1	0	0.9	0	0.3	0.7	0.9
0	0	0	1.0	0	0.3	0.7	0	0	0	1.0	0	0.3	0.7	1.0

husband is not working or when the probability of getting a job offer is higher than 0.5. Hence the negative relation between the husband and wife in the conservative family is evident from this simulation as well.

Simulation 1c
Wife's part-time job offer probability

Conservative family							Modern family							
Wife's distribution				Husband's distribution			Wife's distribution				Husband's distribution			
OLF	UN	PE	FE	OLF	UN	FE	OLF	UN	PE	FE	OLF	UN	FE	p^{w_p}
0.7	0.15	0	015	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	0.0–0.6
0.7	0.09	0.21	0	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	0.7
0.7	0.06	0.24	0	0	0.3	0.7	0	0.2	0.8	0	0	0.3	0.7	0.8
0	0.1	0.9	0	0	0.3	0.7	0	0.1	0.9	0	0	0.3	0.7	0.9
0	0	1.0	0	0	0.3	0.7	0	0	1.0	0	0	0.3	0.7	1.0

An increase in the probability of receiving a part-time job offer will transfer women from a full-time job search to a part-time job search. When the probability of receiving a part-time job offer is between 0 and 0.6, women will choose to search for a full-time job. Only when this probability is 0.7 or more will women start to search for a part-time job. The modern woman will always search for job, and will therefore always remain in the labor force. The conservative woman, on the other hand, searches for a job only when her husband is not working and the probability is lower than 0.9. Therefore her labor supply is *lower* than that of the modern woman, and is negatively related to the husband's labor supply.

Simulation 2 – The Influence of Wage on the Couple's Search Policy

In the model there are three wages – the husband's wage, the wife's full-time wage, and the wife's part-time wage. The wages are notated accordingly: w^{wp}, w^{w}, w^{h}. For simplicity, we assume in all of the simulations that the woman's wage from a part-time job is half her full-time job wage, according to the model specification.

Simulation 2a
Husband's wage level

Conservative family							Modern family							
Wife's distribution				Husband's distribution			Wife's distribution				Husband's distribution			
OLF	UN	PE	FE	OLF	UN	FE	OLF	UN	PE	FE	OLF	UN	FE	W^h
0	0.5	0	0.5	1	0	0	0	0.5	0	0.5	1	0	0	0–23
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	24–31
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	32–53
0.7	0.15	0	0.15	0	0.3	0.7	1	0	0	0	0	0.3	0.7	53+

*An increase in the husband's wage has a positive influence on his LFP, and a negative influence on the wife's LFP***.** If the husband knows that his offered wage will be between 0 and 23, he will choose not to search for a job at all; for a higher wage the husband will search for a job. This analysis is valid for men in both families. On the other hand, there is a difference in the search policies of the two types of woman. The modern wife will choose to search for a job regardless of the wage offered to the husband (she will cease searching only for very high levels of the husband's wage). The wife in the conservative family will choose to search for a job only if the husband's wage level is below 24 or he is unemployed; in such a family there will be a negative relation between the labor supplies of the husband and wife.

Simulation 2b
Wife's wage level

Conservative family							Modern family							
Wife's distribution				Husband's distribution			Wife's distribution				Husband's distribution			
OLF	UN	PE	FE	OLF	UN	FE	OLF	UN	PE	FE	OLF	UN	FE	W^w
1	0	0	0	0	0.3	0.7	1	0	0	0	0	0.3	0.7	0–19
0.7	0.15	0	0.15	0	0.3	0.7	1	0	0	0	0	0.3	0.7	20–22
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	23–26
0	0.5	0	0.5	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	27–55
0	0.5	0	0.5	1	0	0	0	0.5	0	0.5	1	0	0	56+

The results of this simulation show that *an increase in the wife's wage has a positive influence on her LFP, and a negative influence on the husband's LFP***.** Nevertheless, the influence of the wife's wage on the husband's LFP is smaller than that of the husband's wage on the wife's LEP. Men in both families choose to search for a job as long as the women's wage is lower than 56. The modern woman starts to search for a job once her offered wage is more than 22; from this wage level up she will search for a full-time job. A conservative woman will start to search for a job from a wage of 20, but only when the husband is unemployed. As a result, the modern woman's labor supply is higher than that of the conservative woman.

Simulation 3 – The Influence of the Search Cost on the Couple's Labor supplies

*The search cost has a negative influence on the search level of the individuals***.** For low search costs both husbands and wives, in both family types, will search for a job. For a search cost between 2 and 5, men and women of modern families choose to search for a job, while conservative women will do so only if their husbands are unemployed. For a search cost of 6, the modern woman will choose not to search, while the conservative woman will search only if her husband is unemployed. When the search cost rises to 13, both husband and wife in both families will not search anymore.

Simulation 3
Search Cost

Conservative family							Modern family							
Wife's distribution				Husband's distribution			Wife's distribution				Husband's distribution			
OLF	UN	PE	FE	OLF	UN	FE	OLF	UN	PE	FE	OLF	UN	FE	*SC*
0	0.5	0	0.5	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	0–1
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	2–5
0.7	0.15	0	0.15	0	0.3	0.7	1	0	0	0	0	0.3	0.7	6–12
1	0	0	0	1	0	0	1	0	0	0	1	0	0	13+

Simulation 4 – The Influence of Children on the Couple's Labor supplies

*The number of children in the household has a negative effect on the woman's LFP***.** Men's LFP, on the other hand, is not influenced by the number of children. This asymmetry results from the difference in wage levels between the husband and wife. Since the husband's wage is higher than the wife's wage, the most efficient division of assignments between the husband and wife is that the husband is the breadwinner while the wife stays at home and takes care of the children. Therefore, men of the two family types choose to search for jobs regardless of number of children. In a conservative family, if the husband fails to find a job, he stays at home and supplies the children's need for their parents' leisure, the wife will then search for a job to supply their consumption. Hence, the children reinforce the negative relations between the husband's and wife's labor supply. In the modern family the wife searches for a full-time

Simulation 4
Number of children in the household

Conservative family							Modern family							
Wife's distribution				Husband's distribution			Wife's distribution				Husband's distribution			
OLF	UN	PE	FE	OLF	UN	FE	OLF	UN	PE	FE	OLF	UN	FE	*N*
0	0.5	0	0.5	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	1
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	2
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	3
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	4
0.7	0.15	0	0.15	0	0.3	0.7	1	0	0	0	0	0.3	0.7	5

job when she has 1 to 4 children; only at the fifth child will she leave the labor force. The modern wife's labor supply is therefore higher than the conservative wife's labor supply.

Simulation 5 – The Influence of the Risk Aversion on Couples' Labor supply

An increase in ϕ *decreases the search profitability for husband and wife, thus decreasing their labor supplies*. As ϕ rises, the added utility from income decreases. The husband and wife will therefore prefer to enjoy their leisure over a job search. The influence of this parameter on the modern wife is weaker than its influence on the conservative wife; the latter chooses her search policy after the husband's income is known, and therefore she is more risk averse, and the parameter's influence on her is stronger. From a certain level of ϕ both husband and wife will prefer not to search for a job.

Simulation 5
Risk aversion coefficient change

Conservative family							Modern family							
Wife's distribution				Husband's distribution			Wife's distribution				Husband's distribution			
OLF	UN	PE	FE	OLF	UN	FE	OLF	UN	PE	FE	OLF	UN	FE	ϕ
0	0.5	0	0.5	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	0–0.006
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	0.007–0.009
0.7	0.15	0	0.15	0	0.3	0.7	1	0	0	0	0	0.3	0.7	0.01–0.013
0.7	0.15	0.15	0	0	0.3	0.7	1	0	0	0	0	0.3	0.7	0.014–0.015
1	0	0	0	0	0.3	0.7	1	0	0	0	0	0.3	0.7	0.016–0.019
1	0	0	0	1	0	0	1	0	0	0	1	0	0	0.02+

Simulation 6 –Encourage Government Policy to Working

We have seen in previous simulations that the number of children has a negative effect on women's labor supply; so, if the government wants to encourage women to join the LF, it can

do so by giving income tax discounts for children. We shall check the discount required to motivate a woman into the LF.

For a wage of 20, if the woman has 1-4 children, she will choose not to search for a job, regardless of the family type. The simulation results show that for woman with 1-2 children, an increase of the wage from 20 to 23 will make a modern woman search for job, and a conservative woman to search only if the husband is unemployed. For woman with 3-4 children the net wage should rise to 24. As before, the increase in the wage will cause the modern woman to search for job, and the conservative woman to search only if her husband is unemployed. To summarize, relieving the tax burden will encourage women to search for a job. The more children there are in the family the higher the required encouragement.

Simulation 6
Tax discount change

Conservative family							Modern family								
Wife's distribution				Husband's distribution			Wife's distribution				Husband's distribution			Net	number of
OLF	UN	PE	FE	OLF	UN	FE	OLF	UN	PE	FE	OLF	UN	FE	salary	children
1	0	0	0	0	0.3	0.7	1	0	0	0	0	0.3	0.7	20	1
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	23	
1	0	0	0	0	0.3	0.7	1	0	0	0	0	0.3	0.7	20	2
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	23	
1	0	0	0	0	0.3	0.7	1	0	0	0	0	0.3	0.7	20	3
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	24	
1	0	0	0	0	0.3	0.7	1	0	0	0	0	0.3	0.7	20	4
0.7	0.15	0	0.15	0	0.3	0.7	0	0.5	0	0.5	0	0.3	0.7	24	

Simulations summary

The aim of the simulations is to demonstrate the influence of various parameters on the job-search policy of the husband and wife, in particular – to illuminate the difference in the labor supply of the two family types. In all of the simulations significant differences are evident: for the same set of parameters the labor supply of the conservative woman is lower than the labor supply of the modern woman. Moreover, we received a strong negative relation between the labor supplies of the member of the conservative family, a relation that hardly exists in the modern family. Since throughout the various simulations, the same utility functions and parameters were used in both family types, the substantial differences must result from the different game being played by the husband and wife in the two types of families.

5. APPENDICES

Appendix 1

1-LFP of Women (1955–2000)

Appendix 2
Multinomial LOGIT model for the LFP of women

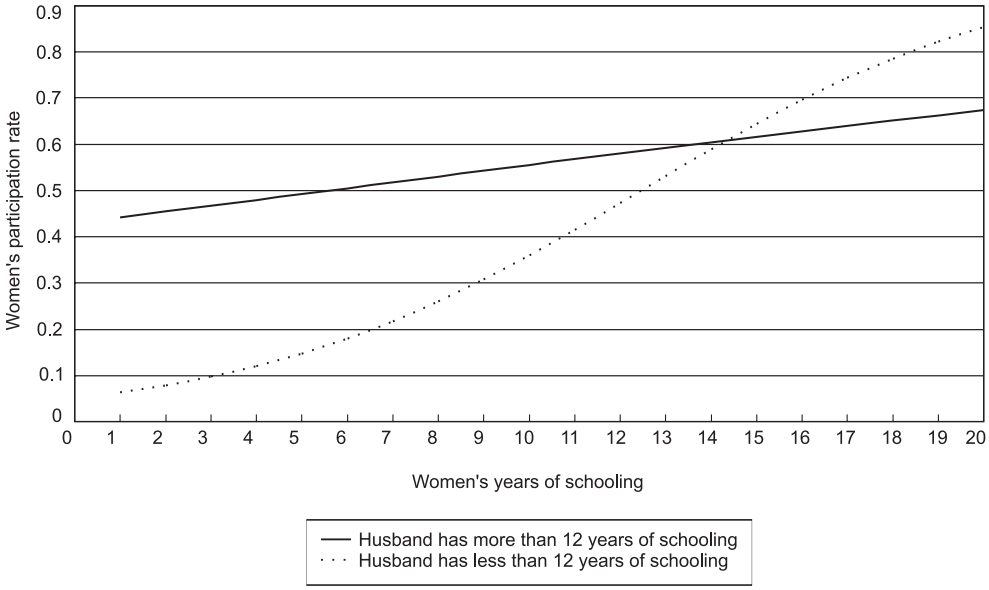
Variable	Unemployed	In part-time job	In full-time job
Constant	–28.882 (11.139)	–11.393 (2.75)	–8.794 (2.396)
Spouse's wage per hour	–0.0002 (0.0002)	0.00003 (0.00003)	1.75E–06 (0.00003)
Spouse's weekly work hours	–0.001 (0.022)	0.00007 (0.008)	0.005 (0.007)
Number of children aged 0–17	–0.890 (0.389)	–0.287 (0.111)	–0.557 (0.111)
Years of schooling	0.221 (0.116)	0.170 (0.052)	0.191 (0.048)
Age	1.292 (0.532)	0.475 (0.129)	0.414 (0.113)
Age 2	–0.016 (0.006)	–0.006 (0.002)	–0.005 (0.001)
Obs.		445	
Likelihood		–461.3127	

Appendix 3
LOGIT model for women's LFP as a function of their spouse's education

Variable	Husband's education above 12 Years	Husband's education below 12 Years
Constant	–6.526 (3.461)	–10.743 (3.009)
Spouse's wage per hour	8.83E–06 (0.00003)	–0.00007 (0.00007)
Spouse's weekly work hours	0.018 (0.011)	0.005 (0.010)
Number of children 0–17	–0.561 (0.148)	–0.380 (0.130)
Years of schooling	0.050 (0.073)	0.235 (0.073)
Age	0.419 (0.165)	0.477 (0.135)
Age 2	–0.006 (0.002)	–0.006 (0.002)
Obs.	221	223
Likelihood	–97.150	–134.424

Appendix 4

Simulation for Women's LFP by Years of Schooling



REFERENCES

Bourguignon, F.;Browning, M.;Chiappori, P.;Lechene, V. (1993) "Intra Household Allocation of Consumption: A Model and Some Evidence from French Data," *Annales d'Eeconomie et de Statistique*, 29: 137-156.

Becker, Gary S. (1974) "A Theory of Marriage: Part II", *The Journal of Political Economy*, 82 (2): 11-26. Becker, Gary S. (1974) "A Theory of Marriage: Part I", *The Journal of Political Economy*, 81 (4): 813-846. Burdett, K. and Mortensen, D.(1978) "Labor Supply under Uncertainty," in: Ehrenberg, R. (ed.) *Research in Labor Economics*, Greenwich, Conn.:JAI Press

Eckstein, Z. and Wolpin, K. (1989a) "Dynamic Labour Force Participation of Married Women and Endogenous Work Experience," *Review of Economic Studies*, 56(3): 375-390.

Eckstein, Z. and Wolpin, K. (1989b) "The Specification and Estimation of Dynamic Stochastic Discrete Choice Models: A Survey," *Journal of Human Resources*, 24, 562-598.

Eckstein, Z. and Wolpin, K. (1999) "Why Youths Drop Out of High School: The Impact of Preferences, Opportunities and Abilities," *Econometrica*, 67(6):1295-1339.

Heckman, J. and MaCurdy, T. (1980) "A Life Cycle Model of Female Labour Supply," *Review of Economic Studies*, 47: 47-74.

Heckman, J. and MaCurdy, T. (1982) "Corrigendum on A Life Cycle Model of Female Labour Supply," *Review of Economic Studies*, 49:659-660.

Heckman, J. (1974), "Effect of Child-Care Programs on Women's Work Effort," *Journal of Political Economy*, 82(2), S136-S163

Hotz, V. and Miller, R.(1988) "An Empirical Analysis of Life Cycle Fertility and Female Labor Supply," *Econometrica*, 56(1): 91-118.

Koorman, P. and Kapteyn, A. (1990) "on the Empirical Implementation of Some Game Theoretic Models of Household Labor Supply," *Journal of Human Resources*, 25: 584-598.

Leutold, J.(1968) "An Empirical Study of Female Income Transfers and the Work Decision of the Poor," *Journal of Human Resources*, 3: 312-323.

Mincer, J.(1993) "Labor Force Participation of Married Women: A Study of Labor Supply," *Collected Essays of Jacob Mincer*, vol.2 , U.K

McElroy, M. and Horney, M.(1981) "Nash-bargained Household Decisions: Toward a Generalization of the Theory of Demand," *International Economic Review*, 22: 33-349.

Van Der Kkaauw, W. (1996) "Female Labour Supply and Marital Status Decision: A Life-Cycle Model," *Review of Economic Studies*, 63(2):199-235.