Parental Benefits, Employment and Fertility Dynamics

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Abstract

This paper investigates the effect of parental benefits on the timing and spacing of births and on employment dynamics of Swedish women. Using microdata on wages and incomes, I estimate a reduced-form multistate duration model of the bivariate life cycle fertility and employment process. The paper provides an example of the application of empirical procedures to develop and evaluate multistate hazard models. Estimation results are mixed with estimated wage effects generally consistent with theoretical predictions while estimated effects of the benefits are not. The evaluation procedures offer valuable diagnostic information and suggest several avenues for future research.

1.0 Introduction

Sweden is renowned for having a generous and extensive set of programs directed at families and children. Since 1955, Sweden has offered universal guaranteed cash benefits and replacement of labor market earnings at the event of childbirth. By 1980, either parent in Sweden was entitled to receive 90 percent of their labor market earnings for up to nine months to stay home and care for a newborn. The large cash transfers involved and the existence of similar though less generous programs elsewhere in Western and Eastern Europe make Sweden's experience an interesting experiment by which to evaluate the impact of these programs on fertility and employment dynamics of women. The substantive focus of this paper is to isolate the effect of these programs on lifecycle fertility and female employment decisions.

Previous studies find that coercive policies, such as in China (Aird 1978), including those involving abortion, have a measurable but usually short-run effect on fertility (McIntosh 1986). The most favorable evidence of the effect of cash incentives on fertility is from analysis of programs in Eastern Europe (Demeny 1986, McIntosh 1986). However, the estimated effects are quantitatively small, so that use of cash incentives to stimulate fertility is prohibitively expensive. While these conclusions are widely accepted, little is known about the programs' transmission mechanisms on fertility behavior. It is not known whether the programs operate directly on fertility choice or only indirectly through employment.

As an initial attempt to illuminate these mechanisms, this paper investigates the effect of parental benefits on the timing and spacing of births and on the employment dynamics of two recent cohorts of Swedish women. I analyze individual fertility histories in the 1981 Swedish Fertility Survey and use individual data on earnings and taxes obtained from personal tax returns for survey respondents and their partners from 1968-80 to calculate wage and income measures. I estimate a reduced-form multivariate hazard model of the bivariate fertility and employment process to provide direct information on the transmission mechanism of the programs on these choices.

The work-conditioned structure of the most generous childbirth benefits generate complicated incentive effects for employment and fertility decisions. To understand these effects I apply a simple model of lifecycle decision making and derive shadow prices that summarize the economic incentives facing households. Knowledge of the components of the shadow prices is used to specify covariates in each of the hazard functions and provide predictions on the expected effect of the economic variables. Use of the shadow prices offers a more refined analysis than simply adding time dummies to capture the changing generosity of childbirth programs. The interpretative difficulties of such analyses are well-known and recently well-summarized by Büttner and Lutz (1990).

The estimation results are mixed. The estimated effects of female wages and male income on fertility exhibit a similar algebraic sign pattern though statistically less precisely determined as presented in Heckman and Walker (1990a). As in the previous study, these variables exert their largest influence on the first birth. The estimated effect of current wages are generally in agreement with a forward sloping labor supply schedule. Estimated male income tends to delay entry into employment, also in accordance with theoretical expectations. There is weak evidence that increases in the work-conditioned childbirth benefits increase employment. However, in conflict with theoretical predictions, the direct effect of childbirth benefits is to lengthen birth intervals and to reduce fertility. Additional research is needed to resolve the source of this discrepancy.

Multistate hazard models are a powerful analytical device for investigating lifecycle behavior, yet little is currently known about their formulation, implementation, and development. My analysis of the Swedish data considers some of the modeling issues and illustrates an application of model evaluation and selection procedures to a large multistate hazard model. I adopt an eclectic approach to model evaluation one, that combines conventional specification tests with procedures that translate the estimated coefficients into predictions of observed dimensions of the bivariate process. I advocate a variety of procedures, some informal and some formal because they complement each other in important ways and because no single procedure will be adequate in all situations. Conventional specification tests are usually computationally simple and may be applied when considering nested model specifications. Multistate hazard models frequently admit nonnested specifications and are inherently nonlinear complex entities with important linkages among transitions. Moreover, visual inspection and tests of the estimated coefficients yield little direct information on the dynamics of the estimated model. Numerical procedures yield quantitative measures of model performance and can be tailored to assess specific features of the candidate models. Diagnostic information on the potential source of model misspecification is particularly valuable, and as shown in the analysis of the Swedish data, offers specific avenues for future analyses.

The presentation of the results is as follows. The next section discusses the Swedish programs and economic environment during the sample frame (1954-1981). Section 3 presents the interpretative framework for understanding the expected effects of the programs on individual decision making. Section 4 presents the econometric framework for the analysis. The data are presented Section 5 and empirical results reported in Section 6. A few concluding remarks appear in Section 7.

2.0 Institution Background on Swedish Programs and Economic Conditions

By the 1960s, Sweden had completed the basic safety net of social insurance programs that guarantee an adequate standard of living (Einhorn and Logue 1989). A key element in this safety net is the national health insurance system instituted in 1955. Sweden was one of the first countries to offer universal guaranteed cash benefits and replacement of labor market earnings. Under this system, effectively all residents of Sweden are covered by sickness insurance and are entitled to in-kind medical services, sickness cash benefits, and maternity (since 1974 parental) cash benefits. The system paid a basic maternity allowance[1] of 270 Kronor (in 1955) at childbirth to all mothers insured by the general health insurance system (i.e., effectively all women). A supplementary allowance was also available to every mother who was gainfully employed and had been insured (for general health insurance benefits) for not less than 270 days before (the expected date of) childbirth, on an annual income of at least 2600 Kronor. Supplementary benefits varied according to the woman's income and were paid for a maximum of 180 days for the continuous period the woman was away from her employment in connection with childbirth. Basic and supplementary maternity cash allowances were not subject to national or local income tax and were designed to replace approximately 80 percent of the woman's labor market earnings. Benefit schedules (basic and supplementary) were revised in 1963 and 1967.

The 1970s was a decade of active policy making. While few new policies were implemented, major reforms occurred in several areas. For example, in 1974, the system of maternity benefits was replaced by a parental benefit program, whereby either parent became entitled to receive cash benefits to remain home in connection with childbirth. Extending coverage to include both parents explicitly recognized and encouraged the father's parental responsibilities. Benefits were paid at the guaranteed level or at 90 percent of the parent's daily earnings, whichever was larger. In 1974, the minimum daily guaranteed rate was 25 Kronor and parents could draw benefits for a maximum of 180 days. Parental benefits are taxable and are

[1] In the subsequent discussion, parental benefits encompasses both maternity allowances (1955-1973) and parental benefits (1974-1981).

counted as earnings in determining an individual's state-provided pension.

In 1978 special cash benefits were introduced. In addition to the 180 days of basic parental benefits, special benefits extended another 90 days. A parent receives the sickness insurance rate for the first 60 days and receives the guaranteed minimum for the remaining 30 days. Special benefits may be used anytime before the child is eight years old. Special benefits were extended to 180 days in 1980. Parents are entitled to their sickness insurance rate for 90 days and the guaranteed benefit rate for the remaining 90 days. The guaranteed benefit was increased to 32 k in 1975 and to 37 k in 1980. Appendix A presents a complete summary of the changes occurring in the parental benefit program.[2]

The local Social Insurance Board office administers benefits and determines eligibility for supplemental benefits. During the sample period to be eligible for supplemental benefits, individuals must be employed for six consecutive months or twelve of the last twenty four months (Gustafsson and Jacobson 1985). Until 1984, a father was entitled to receive 90 percent of his earnings only if the mother was insured for a cash benefit exceeding the guaranteed minimum. Hoem (1990) notes that bureaucratic practice evolved during the 1970s to permit the retention of supplemental benefits without the requirement to re-enter the labor force. Formalized in 1980, individuals remain entitled to benefits for a birth occurring within a period of six months beyond the duration of parental benefits. However, for the sample period this change will have little effect because it requires two births within thirteen to fifteen months.

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[2] Two other cash benefits directly connected with childbirth exist, but because of their limited duration and special nature are not included in the analysis. First, since 1974 in addition to parental benefits the father is eligible for 10 days of leave in connection with childbirth (the so called "ten day rule"). Also, a pregnancy benefit was introduced in 1980, which is payable to expectant mothers who are unable to do their job during the final stages of pregnancy because of the strenuous nature of their work. Paid at the sickness benefit rate, the benefit is payable for a maximum of 50 days during the last two months of pregnancy.

During the 1960s, sickness insurance was financed in part by contributions from insured persons and partly from general revenue. Individual contributions were replaced by employer contributions as part of the general uniform levy for social insurance programs during the 1970s. Employer contributions comprise 85 percent of the funds with general revenues contributing the remaining 15 percent (Olsen 1986).

In addition to the childbirth benefits, two other legal reforms occurred in the 1970s that may be expected to affect fertility and employment. First, a major revision in family law came into effect in January, 1974. The new rules on divorce provided a coherent legal definition of marriage that incorporated for the first time the new forms of family structure (Agell 1979). The 1974 revision recognized the principle that cohabitation is a voluntary union and that family law should be neutral with respect to the form of the union, whether formal (marriage) or informal (consensual). Consequently, no-fault divorce was instituted by the revision. Cohabiting couples have the same rights and responsibilities regarding children and property as do married couples. Second, the abortion law of 1974 (commencing in 1975) recognized existing practice and made abortion virtually free on demand.

Of course, other factors that may influence employment and fertility decisions changed during the sample period. Sweden's extensive income tax system underwent several revisions during the sample period. Most notable are the tax reforms of 1966 and 1971, which redefined the basic tax unit from the family to the individual. The 1966 law gave couples of the option of filing joint or separate returns; the 1971 law mandated separate returns. Hence, since 1971, women are individually taxed on their labor market earnings (joint taxation on assets remained for married couples and couples with children).

The tax reforms had the effect of reducing the tax rate facing women. Tax rates, however, trended upwards during the sample period as tax schedules were revised almost every year. To illustrate the trend in income taxes, Figure 1 plots the average income tax rate for a single woman employed full-time in the industrial sector and the comparable tax rate for an otherwise identical woman married to a man employed full-time in manufacturing. With the adoption of individual taxation in 1971, tax rates coincide as tax schedules become independent of demographic characteristics. Until the reform in 1971, because of joint taxation average tax rates of married women were 5 to 7 percentage points higher than for single women (and of course differences in marginal tax rates were much greater between groups). By considering only the income tax, Figure 1 understates the secular increase in average tax rates. Increases of the Value Added Tax coincide with reductions in the (national) income tax rate. Even with ignoring the VAT, tax rates in Sweden were high, with average rates of 30 percent not unusual.[3]

The most distinctive feature of the Swedish economy is its wage determination policy. From the mid-1950s until 1983, wages were set by collective bargaining agreements between the national unions and the national employer's association. A basic principle of the national collective bargaining agreements which reflects Swedish egalitarian beliefs is the "solidaristic wage policy" whereby wages should not depend on industry profitability or an individual's productivity. Developed by the national trade union, it became part of the national agreement in the late 1950s. Studies by Björklund (1986), Flanagan (1987), and Hibbs (1990) document that since the mid-1960s the solidaristic wage policy has been effective in compressing all aspects of the wage structure (e.g., wage variation due to age, experience, gender, regional, educational, and industry differentials). Implementation of this policy provides an important explanation for the rise in female wages from 65 percent to 90 percent of male wages by 1980.

[3] For a complete discussion of the tax and social insurance benefits in Sweden during the last thirty years see Aronsson and Walker (1995).

3.0 Interpretative Framework

Following much of the previous work on lifecycle behavior (e.g., Heckman and MaCurdy 1980, MaCurdy 1981, Moffitt 1984, and Cigno 1991), I exposit a perfect foresight model to assess the effects on lifecycle employment and fertility behavior induced by changes in the childbirth programs and economic environment.

The consumer obtains utility from a composite consumption good x_t, leisure, l_t, and the flow of child services C_t. The latter is assumed proportional to the number of children $n_t = \sum_{l=1}^{t} b_l$, where b_t is fertility in year t. There is no bequest motive, and consumer preferences are intertemporally and contemporaneously strongly separable $U = \sum_{s=t}^{T} \beta^s [v(n_s) + u(x_s) + \omega(l_s)]$, where β=1/(1+ρ), and v(•), u(•), ω(•) have the usual properties. The terminal period occurs at age T, and the first decision is made at time period 1. Assume the total time endowment equals one and is allocated to employment, leisure, and child care and that childbirth and child care requires a fraction φ (assumed exogenous to the household) of the year. Capital markets are perfect. Denote the constant rate of interest as r and the discount factor as $\delta_t = (1+r)^{-(t-1)}$.

As described in the previous section, the parental benefit program has a universal component available to all individuals and a supplemental component to replace lost earnings. Let g_0 represent the universal or guaranteed benefit and let η be the earnings replacement rate so that the earnings related component equals $e_{t-1}W_t\eta$. Represent the entitlement process as a minimum employment threshold. Thus to be eligible for supplemental benefits, the individual must be employed at a level above the qualifying minimum the period preceding a birth. Parental benefits for a birth in period t equals:

$$g(e_{t-1}) = g_0 + d(e_{t-1})[e_{t-1} W_t \eta - g_0]$$

$$d(e_{t-1}) = \begin{cases} 0, & e_{t-1} < e^* \\ 1, & e_{t-1} \geq e^* \end{cases} \qquad \textbf{(1)}$$

Various program reforms occurring during the 1970s are captured by equation (1). Increases in the replacement rage (e.g., from 80 to 90 percent) and increases in the length of benefits (e.g., from 6 to 9 months) are equivalent to increases in η. Changes in the universal benefit change g_0. Loosening of the eligibility criterion translates into reducing the minimal level of employment. Notice the benefit rule incorporates two motives for employment: the individual must work enough to qualify for supplemental earnings, and once qualified additional employment in the period before a birth directly increases childbirth benefits.

Assume parental benefits are financed by a proportional tax on earnings at rate τ_t and that initial assets are zero. Denote the present value of spousal earnings as A_0 and the price of the consumption good as p_t. The consumer's decision problem is

$$\max_{\{b_t, x_t, l_t\, t=1,\ldots,T\}} \sum_{t=1}^{T} \beta^{t-1}\left[v(n_t) + u(x_t) + \omega(l_t)\right]$$

$$\textit{subject to}$$

$$A_0 = \sum_{t=1}^{T} [(1-\tau_t) w_t e_t + g(e_{t-1}) b_t - p_t c_t] \delta_t$$

$$\varphi b_t + e_t + l_t = 1 \qquad \textbf{(2)}$$

$$n_t = \sum_{j=1}^{t} b_{t-j}$$

$$0 \leq b_t < \overline{B}$$

A woman selects the lifecycle consumption, employment and fertility levels (x_t,e_t,b_t, t=1,...,T) subject to the budget constraint, the time constraint, and a biological restriction on the maximum fertility in a period. Substituting the time constraint for l_t, assuming that the upper limit on the biological constraint is not binding, and denoting the Lagrange multiplier on the budget constraint as λ, the first order conditions for the constrained optimization problem are:

$$\begin{aligned} \beta^{t-1} u'(x_t) &= \lambda p_t \delta_t \\ \beta^{t-1}\omega'(1-e_t-\varphi b_t) &= \lambda \delta_t \pi_t^e \qquad t=1,...,T \\ \sum_{j=t}^{T} \beta^{j-1} v'(n_j) - \lambda \delta_t \pi_t^b &\le 0 \end{aligned} \tag{3}$$

where π_t^e is the shadow price of employment, and π_t^b the shadow price of fertility in period t (discussed below). If we let V_t denote $\beta_{t-1}\omega'(1-e_t-\varphi b_t)$, then one informative way to summarize the first order conditions for employment is

$$\frac{V_{t+1}}{V_t} = \frac{\pi_{t+1}^e}{\pi_t^e}. \tag{4}$$

This relation characterizes how women allocate employment over their lifecycle conditional on the lifecycle profile of wages and incomes. Behavior is driven by this intertemporal arbitrage condition: in equilibrium, the marginal rate of intertemporal substitution must equal the economic rate of substitution between periods. The left side of equation (4) is the price the woman is willing to pay to shift leisure from period to t to t+1. The right side is the price available in the market to transfer leisure between periods.

Even with the strong assumptions on preferences and child care technology, in periods when the household is not at an interior solution this model does not have the simple structure of many lifecycle labor supply models. The cumulative utility flows from children $\sum_{j=t}^{T} \beta^{j-1} v'(n_j)$, imply that the conditional demand for child services will depend on current and future prices (invert the second equation in (2) and solve recursively from period T): $n_t = n_t(\lambda\pi_t^b, \lambda\pi_{t+1}^b, ..., \lambda\pi_T^b)$.

However, there is still sufficient structure to gain insight into lifecycle decision making. Notice the cumulative flows of utility accruing to fertility in period t (the last equation in (3)). This is the primary force to have children early in the lifecycle. The timing of births results from the tension between having children early in the lifetime and the desire to have them when their price is low.

The shadow prices for employment and fertility carry most of the interesting insights on the dynamic process. These shadow prices are:

$$\begin{aligned} \pi_t^e &= w_t^* + \delta b_{t+1} \frac{\partial g(e_t)}{\partial e_t} \\ \pi_t^b &= \varphi w_t^* - g(e_{t-1}) + \delta b_{t+1} \frac{\partial g(e_t)}{\partial e_t} \end{aligned} \qquad \textbf{(5)}$$

where w* is the reservation wage, equal to one minus the tax rate times the market wage if the individual is employed, otherwise the reservation wage equals the value of time at zero employment. As often occurs in dynamic models, opportunities today depend on past decisions and (expected) future decisions. Hence, unlike market prices, these shadow prices are endogenous. Evaluated along the optimal path, they are informative of the incentives facing households. For example, the return to employment is this period's wage and, for those anticipating a birth next period, the incremental discounted increase in benefits from employment this period. For individuals entitled to employment related benefits ($d(e_{t-1}) = 1$), the employment shadow price equals $(1-\tau_t)w_t + \delta b_{t+1}\eta(1-\tau_{t+1})w_{t+1}$; employment increases benefits along an intensive margin. Other things constant, individuals have an incentive to become employed before having a child next period.

We can also think about increasing employment in a way that changes the entitlement status. In this case, employment may be thought of as a binary outcome (employed/not employed) with an eligibility requirement equal to full-employment. In this case, employment determines payment but also entitlement status. The gain to employment is then the difference between supplemental benefits and the guaranteed benefit: $\pi_t^e = (1-\tau_t)w_t + \delta b_{t+1}(\eta(1-\tau_{t+1})w_{t+1} - g_0)$. The empirical analysis adopts this perspective and uses the term after the plus sign to represent the value of supplemental benefits.

Regarding the price of fertility, consider first the situation where next period fertility is zero. The price of fertility is the opportunity cost of time less the value of parental benefits:

$$\pi_t^b = \begin{cases} \varphi w_t^* - g_0, & d(e_{t-1})=0, \\ (\varphi - \eta e_{t-1}) w_t^*, & d(e_{t-1})=1 \end{cases} \qquad \textbf{(6)}$$

Parental benefits offset the price of fertility; an increase in the guaranteed rate or in the forgone earnings replacement rate has an unambiguous direct pronatalist effect on fertility (the price and wealth effects work in the same direction). If future fertility is not zero then the shadow price of fertility acquires an extra cost reflecting the interaction of employment and fertility processes. If, as seems reasonable, employment decreases in periods of childbirth and results in lower benefits for the subsequent birth, then the interaction term captures this increased cost from closer spacing of fertility.

This framework reveals that parental benefits have three separate effects on the employment and fertility process.[4] First, the entitlement effect provides an incentive to enter the labor force prior to each birth. The magnitude of this effect increases with the difference between employment-related and guaranteed benefits and with the proximity of the birth. Second, total

[4] If capital markets are imperfect, then parental benefits and spousal earnings have an additional role to play. When couples cannot smooth consumption through savings, benefits offer the household additional income thereby extending household resources and reducing the incentive to delay childbearing. Thus, with imperfect capital markets, increases in child care benefits should increase the tempo of fertility for the first child.

parental benefits also reduce the direct cost of the birth and should stimulate fertility. The effect is largest for individuals entitled to receive earnings-related benefits. Third, following a birth, parental benefits provide additional income to the household and (assuming leisure is a normal good) should reduce the incentive to return to employment. Increases in either the guaranteed benefit or the replacement rate will delay a return to employment. While the entitlement effect is forward looking, this effect depends on past behavior -- consuming benefits tied to the last birth. Combining the latter two effects on the employment process implies that increases in parental benefits should tilt the reemployment hazard following a birth for households planning an additional child. Immediately following the birth, consumption of benefits from the birth will lower the reemployment hazard, while at longer durations the entitlement effect becomes operative as the woman needs to reenter the workforce to become eligible for benefits associated with the next birth. In particular, since most Swedish households have two children, the effects should be most pronounced for the employment process following the first birth.

4.0 Empirical Procedures

This section outlines the empirical strategy to recover the program effects described in the previous section. The next subsection describes the state space and briefly summarizes the construction of the likelihood function. Subsection 4.2 presents the parameterization of the hazard functions. Subsection 4.3 describes model evaluation procedures.

4.1 The Likelihood Function

Figure 2 presents a schematic representation of the state space. In this process, states are defined by (birth) parity and by employment status. Employment status is restricted to two states, employed and not employed, whereas separate states are defined for each parity of the fertility process. To incorporate the biology of the reproductive process, separate states are included (by employment status) for pregnancy. These pregnancy states are also important for keeping the sequencing of events correct. Many women conceive while employed and leave the labor force immediately prior to the birth. Disregarding pregnancy would make it appear that women decide to schedule their births when nonemployed and would give a distorted view of the relationship between employment and birth decisions.

The most direct way to define the likelihood function for this stochastic process uses the exit rate formulation. Denote the waiting time random variable as T and the covariate vector as Z. For now, consider Z as containing only exogenous covariates. Denote the overall hazard rate from state I as

$$h_i(t|Z)=\lim_{\Delta t\to 0}\frac{Pr(t\le T<t+\Delta t|T\ge t,Z)}{\Delta t}.$$

Define the cause-specific hazard from state I to state j as

$$h_{ij}(t|Z)=\lim_{\Delta t\to 0}\frac{Pr(t\le T<t+\Delta t,J=j|T\ge t,Z)}{\Delta t}.$$

Then, assuming the states are mutually exclusive, by the law of total probability $h_i(t|Z)=\sum_{j\in C} h_{ij}(t|Z)$.

where C denotes the set of all states. The survivor function for state I is well defined and is $S_i(t|Z)=\exp\left[-\int_0^t h_i(u|Z)du\right]$. The (sub)density for the waiting time random variable for a transition

from state I to state j is $f_{ij}(t|Z)=h_{ij}S_i(t|Z)$.

Define R(k) as the value assumed by a finite state continuous time stochastic process at the time of the kth transition. Assume that the start of the process is calendar time zero. The process starts at menarche, when the woman is in her early teens and before she has entered the labor force, therefore R(0)=1. The woman remains in state 1 a random length of time, T_1, with movement out of state 1 governed by the survivor function $S_1(t|Z)$. At time $T_1=t_1$ the woman exits state one and enters state j, R(1)=j=r(1). Movement from state j is governed by the survivor function $S_j(t \mid Z, t_1)$. Departure from state j occurs at time $T_2=t_2$ and the woman transits to state k, R(2)=k. Note the time spent in state j equals T_2-T_1. The generic transition, say the m^{th}, is governed by the survivor function $S_m(t \mid Z, t_1, r(1), t_2, r(2),..., t_{m-1}, r(m-1))$.[5] The last observation on the process occurs at the survey date. At that time each individual will be observed in an open (censored) spell.

The likelihood contribution for the l^{th} person observed at survey date M with K completed spells and a K+1st spell censored at time $\tau = M - \sum_{k=1}^{K} t_{i_k j_k}$ is simply the product of subdensities for the completed spells times the survivor function for the censored (last) spell:

$$\mathcal{L}(\theta \mid t, X) = \left[\prod_{k=1}^{K} f_{i_k j_k}(t_k \mid X, \theta) \right] \cdot S_{i_{K+1} j_{K+1}}(\tau \mid X, \theta)$$

where θ denotes the parameters to be estimated, and for notational simplicity I have included all exogenous and past-dependent covariates (indicators for the previous states visited and the length of the spell in each) into X. In the absence of an unobserved individual specific component, the specification is a standard parametric (finite) model so (under the usual regularity conditions)

[5] The only additional technical point regards the handling of the pregnancy spells. Date of conception is not observed but is obtained as date of birth less nine months. The deterministic nature of the pregnancy durations violates the conditions in Yashin and Arjas (1988) that relate the conditional hazard and survivor function. To permit the usual representation theorems to apply, a random component is added to the pregnancy intervals. Formally, time pregnant is time spent in a non-fecund state and so adding the additional random component randomizes the return to menses (not the date of birth of the child) and does not affect the employment process. The nonfecund periods are modeled as having an equal probability of either ten or eleven months. The estimated effects are not sensitive to the assumed distribution.

maximum likelihood procedures retain their classical large sample optimality properties. With no individual unobserved heterogeneity component or coefficient restrictions across transitions, the log likelihood function can be written as the sum of the individual transitions and each transition can be estimated separately. (See Flinn and Heckman 1982, 1983 and Heckman and Singer 1985 for additional discussion on model estimation.) The estimates reported in Section 6 were obtained using the CTM software (Flinn and Heckman 1982, Heckman and Walker 1987).

As noted in the preceding discussion, the history of the process is easily incorporated into the likelihood, so that cause-specific hazard functions may include past outcomes and waiting times as regressors (e.g., r(j) and t_j). Of course, dimensions of fertility and employment decisions that are not modeled cannot be used as conditioning variables. For example, modeling the binary employment process status (employed, not-employed) does not permit conditioning on hours of work.

The ability to condition on previous endogenous outcomes is important for the analysis of the childbirth program. While program parameters (e.,g., the guaranteed benefit or the earnings replacement rate) are exogenous to the individual, an individual's entitlement depends on his or her earnings and hence on his or her previous choices. Unlike a birth model which captures only endogenous fertility decisions, the bivariate process controls for endogenous employment decisions as well.

4.2 Specification of the Hazard Functions

I represent the conditional hazard to model the transition from state I to state j using the following functional form:

$$h_{ij}(t_{ij}|\cdot)=\exp\{\gamma_{0ij}+\sum_{k=1}^{K_{ij}}\gamma_{kij}\frac{t^{\lambda_{kij}}-1}{\lambda_{kij}}+Z(t_{ij})\beta_{ij}\}. \quad \textbf{(8)}$$

where **Z**(t) includes all observed covariates (e.g., after-tax female wage and program variables) and possibly information on previous states and their spells. Hazard function (8) encompasses a variety of widely used models; however, I specialize the representation to an exponential model, γ_{kj}=0 for all k=1,...,K_j because of the short durations of most intervals and because controls for the woman's (current) age are included in all transitions.

4.3 Model Evaluation

Available estimation software permits a number of interesting duration models to be considered. Since so many different models can be estimated, the user faces the difficult problem of model selection. It would be desirable to have an objective procedure to determine which specification is best supported by the data. Model selection for multispell models is complicated in part by the absence of a large body of previous empirical work to guide model specification. It is frequently not possible to use prior information to aid in model selection (e.g., do the estimated coefficients have the "right" sign and are they "reasonable" in light of previous estimates?). Indeed, in many situations the empirical work is undertaken to develop a set of empirical regularities that can be used to guide subsequent theoretical modeling.

Conventional statistical model selection procedures require that the class or family of the true model be specified and that all competing specifications be nested versions of a general model. For nested models, conventional likelihood ratio, Wald and Lagrange Multiplier tests can be used to decide among competing specifications. Such pretesting strategies for model selection can be justified only asymptotically. They fail when models are nonnested. In such nonnested comparisons, ranking models by their likelihood values does not produce the "true" model, nor does it produce a model with any optimality properties (unless, of course, obtaining the largest likelihood is the goal). Ranking models on the basis of the likelihood values rewards complex models with many parameters, which may do very poorly in generating out-of-sample forecasts.

In light of these difficulties I adopt an eclectic stance that recognizes that different procedures yield different types of information. Conventional statistical tests based on the likelihood function have a well-developed theoretical foundation and should be used to discriminate among nested models. Direct tests of estimated coefficients may yield evidence of misspecification, but frequently provide little diagnostic information. Duration models are inherently nonlinear and multispell models are typically complex entities with important linkages across transitions. In this setting, the coefficients are difficult to interpret and visual inspection of the estimated coefficients frequently yields little information on the dynamics of the process. The interdependent nature of multispell models means that a covariate's effect includes the direct effect estimated by its coefficient and its indirect effect which is transmitted through the incidence and timing of exposure to different risks of the process.[6] Consequently, procedures are needed to assess the quantitative significance of the covariates and to put nonnested models within a common metric.

Measures based on an observed dimension of the dynamic process I label as predictive procedures.[7] Although most commonly applied within sample, I adopt this terminology because some calculation is necessary to transform the estimated parameters to the dimensions of the process. The presumption is that a small but common set of parameters generate the observed data. We exhaust some aspects of the data to estimate the parameters. However, in a correctly specified model the estimated parameter should be able to replicate any other dimension of the

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[6] Thus, in the hierarchical birth process, covariates determining the hazard of the first birth have indirect effects on subsequent births through changing the exposure rate and the conditioning variables. For example, individuals with a longer first birth enter exposure to the second birth at a later date and may face different economic conditions than those with a shorter first spell.

[7] Heckman and Walker (1987) discuss the algorithm to numerically implement these procedures.

data. A large deviation between the sample and predicted quantity from the estimated model is evidence then of misspecification. χ^2 goodness-of-fit tests are one way to develop formal test procedures. (See Heckman and Walker (1987).) However, informal applications are also informative. Using the estimated parameters to simulate the multispell process is a natural, and absent an analytical representation, the only way to learn about process dynamics. Evaluating the model to obtain the predicted quantities provides direct information on the behavior of the estimated model within the context of the underlying behavioral model. That is, predictive procedures shift the model evaluation task from purely statistical grounds to substantive behavioral grounds. Dimensions in which a model fits poorly are clearly identified and the common metric allows competing specifications to be ranked according to the dimensions evaluated. Rather than as an acceptance or rejection criterion, I view these procedures as providing a continuous quantitative measure to approximately order competing empirical specifications. Predictive procedures are not a panacea nor is it possible for the analyst to test his or her way to identification. However the procedures provide interpretable information, are easy to compute, and are invaluable for summarizing the complex behavior of multispell duration models.

There are many dimensions on which one might wish to judge the adequacy of any fitted multispell duration model. The use of several criteria to evaluate fitted models may produce conflict in model ranking and thus may inject an element of uncertainty in model choice. Use of a single criterion is arbitrary because it implicitly restricts attention to certain features of the multivariate distribution. Yet, the context usually identifies certain features or dimensions of the distribution that are of special interest. Moreover, multivariate distributions are complex entities. The more features we examine, the more we learn about the process under study. Until biological or behavioral theory is sufficiently well developed to produce functional form restrictions for hazards or until general statistical theory for nonnested model selection is developed, an analysis of many aspects of fitted multivariate distributions is the best guide to model selection.

Selection of a particular set of dimensions to evaluate reveals the aspects of the process the analyst considers to be most important. While we may question and disagree with the dimensions selected, explicit declaration of these choices (and the arguments in their support) through the use of predictive tests at least brings these considerations and judgements to the attention of the reader (and the analyst). Of course, if these dimensions are of central importance why not incorporate them directly into the estimation procedure? In the context of multispell duration analysis my answer is simply one of convenience. As argued by Flinn and Heckman (1982) and Lancaster (1990) among others, the likelihood function is a convenient device for incorporating time varying variables, general forms of censoring and the connection among transitions.

In the application to the Swedish data, I followed an interative strategy mixing estimation, conventional model selection tests and predictive procedures. Admittedly, an effort was made to find specifications that yield estimated coefficients for the benefit variables consistent with theoretical expectations. Such data-mining exercises overstate the true significance level of the estimated coefficients (pre-test bias), but also yields important insights on employment and fertility dynamics. Requiring that a preferred specification have estimated effects consistent with the predictions of the theoretical model is simply the application of economic theory into the empirical analysis. Although estimating a variety of models violates the precepts of statistical hypothesis testing, not doing so is tantamount to giving no weight to the theoretical predictions. We struggle so hard for such insights it is profligate to discard them. The real issue is how to avoid over-fitting the estimated model.

Working within a class of nested models, I used conventional likelihood based specification tests to winnow alternative specifications. I applied the predictive procedures to the preferred model to guard against over-fitting and arbitrarily imposing a model structure on the data. As described in Section 6.3, I investigate three dimensions of the employment and fertility process. I select these dimensions because they are conventional (so their use provides a direct link to previous work) and are easy to interpret. In the evaluation, I assign the greatest weight to the model's ability to fit the joint employment and fertility process. This dimension provides direct evidence on the theoretical predictions because substantive policy issues center on employment behavior surrounding births. Who leaves the market and for how long? Do work-related benefits increase employment between births? Do more generous benefits lengthen labor market absences following a birth? To provide compelling evidence on these questions requires that the estimated model fit the joint employment and fertility process. Even evidence of misspecification is informative to help guide future research on this increasingly important topic.

5.0 Data Sources and Construction of Time-Varying Economic Covariates

The data used in this study are from the 1981 Swedish Fertility Survey. It is a retrospective survey conducted by Statistics Sweden of native-born Swedish women from the birth cohorts 1936-60. Women are drawn from the Central Population Register by a random sample from five 5-year birth cohorts (1936-40,1941-45,...,1956-60). The survey instrument administered was a World Fertility Survey questionnaire modified to fit the Swedish context. It contains over 100 questions on lifecycle fertility, employment, education, marital and cohabitational events (consensual unions) as well as social background, current life style and future fertility plans. The quality of the survey data is generally considered to be good (Hoem and Rennermalm 1985, Walker 1986). This paper analyzes the members of two cohorts (1941-45 and 1946-50). Both cohorts have approximately 1000 women in each. I select these cohorts because these women experienced the major policy changes during their prime childbearing years and are most likely to reveal behavioral responses to the program changes.

The survey did not gather individual wage and income information. Detailed information on earnings, taxes and some social insurance benefits is available from individual tax returns obtained for the respondents and their partners for the period 1968-1980. I use the earnings data and information on hours of work in the survey to estimate wage rates for women during 1968-1980.

Earnings information for the male partners of the respondents of the SFS is available for the period 1968-80. However, other information on the characteristics of the partners is sparse and the potential endogeneity of this sampling scheme reduces the value of the individual data for men. Consequently, to estimate male income I use the annual male-specific manufacturing wage series. Wage series are highly correlated and the results are not sensitive to the wage series used to estimate male income.[8] I convert all nominal quantities into real terms by deflating with the consumer price index.

Issues of selection, endogeneity, and measurement error are present whenever one considers construction wage measures from microdata. The high female participation rates in Sweden and the solidaristic wage policy minimize the influence of the first two problems. Fewer than one percent of women in all cohorts report never being employed. Moreover, over the sample period, monthly employment probabilities range between 50-80 percent. Effectively, all women work at least once during their life and most women work most of the time. Consequently, the influence of selection (i.e., using the observed wage distribution to measure the true wage distribution of both working and non-working women) on observed wages is small

[8] Earlier versions of the paper made an appeal to positive assortive mating to estimate male income based on the respondent's characteristics (age and education) and calendar year covariates (the manufacturing wage).

and is neglected.[9] Appendix B reports the wage regression to obtain predicted wages for years prior to 1968.

Incorporating the complex and fluid Swedish tax system into the analysis in a parsimonious way is a challenging task. The two-state employment process (employed, not-employed) simplifies the analysis by making the average tax rate the (only) relevant tax concept. This analysis incorporates income taxes by using annual local and national tax schedules and individual data on income, earnings and taxes from 1968-1980 to estimate a tax function. (Appendix B describes the procedures used to obtain the estimated tax function.) The annual average tax rate in year s, T_s, is obtained from the estimated tax function, $\Gamma()$, using predicted female wages, FW(s), predicted partner's income, MI(s), and demographic characteristics (defined below) according to the following rule:

$$T_s = \begin{cases} \dfrac{\Gamma[\delta_m(s) MI(s) + E_f | s, \delta_c(s)]}{\delta_m(s) MI(s) + E_f}, & if \quad s < 1971 \\[2ex] \dfrac{\Gamma[E_f | s]}{E_f}, & if \quad s \geq 1971 \end{cases}$$

where,

$\Gamma(\bullet)$ = Estimated tax function in year s, including national and local tax rates

MI(s) = Predicted male income in year s,

$E_f(s)$ = Predicted female labor market earnings, equal to $FW_l(s)$*2000 (full-time labor force participant),

$\delta_m(s)$ = 1, if the respondent is married or cohabiting in year s, 0 otherwise.

$\delta_c(s)$ = 1, if the respondent has at least 1 child by the end of year s-1, and zero otherwise.

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[9] The large sample size available produced statistically significant (at conventional levels) selection correction terms. However, the empirical magnitudes of the corrections are small and have no effect on the time series properties of the predicted wage series.

Prior to 1971, marital status and the presence of at least one child in the household affect the tax rate, whereas following 1971 demographic characteristics are irrelevant for determining the average tax rate.[10]

Calculation of the three parental benefit measures follow from the schedules reported in Appendix A. The benefit schedules are applied to annual earnings equal to the predicted female wage times the number of months worked during the previous twelve months times 160 hours per month. After 1974 when benefits become taxable, the predicted earnings are used to calculate the average tax rate. This value is labeled "total benefits" and appears in the conception transitions. It is a time varying regressor and changes when any of the components change (i.e., wage rate, eligibility status to supplemental benefits or the tax schedule). FPB denotes the value of parental benefits fixed at conception and receivable at the impending birth. These benefits are fixed within a parity. Because these benefits may (in principle) be used until the child enters school, FPB enters the transitions initiated from employment. The third measure of parental benefits, supplemental benefits, summarize the employment incentive effects. I adopted a discrete-choice perspective on the employment process and supplemental benefits equals the difference between an individual's earnings related benefits and the guaranteed benefits. This is a time-varying covariate that enters into the employment related transitions. For individuals who have not met the employment criterion (i.e., worked at least 6 consecutive months or 12 of the last twenty-four months), supplemental benefits equal zero. All three of the parental benefits are scaled in units of 10,000 kronor.

[10] Notice that all women are assumed to work the same number of hours. This assumption is necessary because the choice of hours is not modeled in the derivation of the likelihood function. The assumption induces an errors in variables problem because presumably individuals respond to their average tax rate, which may be based on only part-time employment and not the estimated average tax rate assuming full-time employment. However, nearly 70 percent of the employment spells recorded in the retrospective employment spell are for 40 hours per week. These annual average tax rates are used to obtain after-tax male income and female wage series.

A few demographic covariates enter to control for nonbenefit and nonwage factors. The woman's age (in months) appears in each transition to control for lifecycle behavioral and biological effects. To proxy for child care costs, the age of each child (in months) appears in all transitions following the birth of the child. Individuals with a strong attachment to the labor market (perhaps because they plan on not having children) will qualify for the largest benefits. Without additional controls, such tendencies will induce a spurious negative relationship between the benefit variables and fertility. As a proxy for unobserved factors that affect a woman's recent attachment to the labor force, the proportion of the previous two years spent employed, “prop employed” is included in transitions not originating from employment.[11]

6.0 Empirical Results

This section offers three forms of evidence. Section 6.1 provides descriptive evidence on the relationships between wages, benefits and employment and fertility. Section 6.2 presents the estimated hazard functions. A review and discussion of the quantitative characteristics of the multistate model appears in Section 6.3. Many of relationships estimated by the multistate model appear in the gross patterns of the data. This suggests the estimated coefficients are not simply the result of imposing a restrictive model structure on the data.

6.1 Time Series Patterns

Before presenting the multistate hazard estimates it is informative to review descriptive information on the relationships in the data. Figure 3 graphs the real female wage, parental benefits for an employed woman, and the total fertility rate calculated from population age-

[11] A measure of expected future wages and current assets should appear, but do not because of data limitations.

specific birth rates. Real female wages and parental benefits trend upward during the sample period. Female wages increase until 1975 when they nearly level off and grow slowly for the remaining five years of the sample period. Maternity benefits exhibited their largest growth during the last five years of the sample period reflecting the increase in the guaranteed rate and the extension of program benefits. The total fertility rate peaks in the early 1960s and declines to the end of the sample period. Indeed, 1978 produced one of the lowest fertility rates observed in the last thirty years as birth rates fell to a level far below the replacement rate (1983 is the other year of equally low birth rates). A comparable plot of maternity and employment ratios reveals that these two quantities are positively related. For every age group, female employment rates increased nearly every year from 1968-80. Female wages and maternity benefits should be positively correlated with the proportion of women employed and negatively related to the fertility.

Table 1 provides another descriptive view of the employment and fertility patterns in the Swedish Fertility Survey. The table reports, for each of the first two conception intervals, the proportion eligible for supplemental parental benefits at the time of conception, the proportion of the interval spent in employment, and the mean length of conception intervals by the calendar time period of the conception. For both conception intervals, the proportion eligible for supplemental benefits increases over time, although the timing of the largest increase differs. For the first interval, the proportion eligible increases steadily, about 5 to 6 percentage points each time period. For the second interval, increases occur in all periods with substantial gains occurring in both of the latter two periods (1971-75 and 1976+). The proportion of the conception interval employed reflects the increasing labor force attachment by women. For the first interval, the proportion employed increases modestly (from 43 to 53 percent). The increase in labor force attachment by women with one child is striking, as it more than triples during the sample period. The mean length of the conception intervals will change if a changing economic and policy environment induces women to change their timing and spacing of births. Essentially all of the increase in the first conception is due to the lengthening exposure interval generated by the cohort structure of the data. Interest centers on the second conception interval. The mean interval length increases across each time period and the small standard error of the means reported in the last column reveal that the longer conception intervals are unlikely to be the result of sampling error.

The patterns reported in Table 1 are consistent with conjectured incentive effects of the increased parental benefit program. Swedish women exhibit greater attachment to the labor force and a concomitant increase in the eligibility for supplemental maternity benefits, with a lengthening of the second birth interval. These statistics suggest that legislative increases in the parental benefit program during the 1970s induced little change on the first interval. Historically, Swedish women worked prior to the first conception and required little or no modification in response to the legislative reforms increasing the generosity of the benefits. However, the lengthening of the second conception suggests women may have postponed their fertility to reenter the labor market and to become entitled for (the increasingly generous) supplemental maternity benefits. The multistate hazard model of the next subsection will investigate this conjecture.

6.2 Multistate Hazard Estimates

Table 2 lists the covariates and the scaling conventions for all variables used in the analysis. Table 3 reports the transition counts and the mean waiting times for each transition for the 1939 women born between 1941-50. The unit of analysis is a spell (whether censored or completed) and each woman contributes multiple observations to the analysis. Notice that lifecycles span as many as 300 months and yet most transitions are relatively short. Also, all transitions have at least 100 completed spells and most transitions have considerably more (suggesting more than adequate sample sizes for the nonlinear estimation).

Estimates of the bivariate fertility and employment process appear in Table 4. Listed down the page in Table 4 are four blocks of estimates. The first block reports estimates for the transition from nonemployment to employment, the second block is the transition from employment to nonemployment, the third is conception while not employed and the last block is conception by employed women. Listed across the page, each transition type is reported by birth parity. Transitions by childless (nulliparous) women appear in the leftmost column, while those with two children appear in the rightmost column. For parity two women there are only enough transitions into employment to estimate hazard coefficients. Transitions while pregnant (e.g., from employment to nonemployment, from nonfecund to fecund while nonemployed are not reported in Table 4. These transitions are short (see Table 3) and are modeled as exponential waiting time random variables (i.e., have only a constant term in the hazard function).

Overall, the estimation results are mixed. With some exceptions noted below, generally the estimated male and female wage effects agree with their expected effects from the theoretical discussion. The discrepancies for the wage variables appear primarily in the transition from employment to nonemployment. For example, among nonemployed women for both the first and second births, the estimated male income effect is negative and statistically significant at conventional test levels. These estimates imply that increases in male income retard entry into employment. Notice the exception however, for childless women increases in male income hasten entry into employment. The estimated effect is also statistically significant but is about one-half the magnitude of that for parities one and two. For all birth parities, estimated female wage effects on the waiting time from nonemployment to employment are positive and statistically significant. Again, the estimated coefficients are larger for women with children (parities one and two).

The estimated wage variables in the nonemployment to employment transition are not precisely estimated (especially for parities one and two), suggesting that exits from the labor market are idiosyncratic and may primarily depend on nonmarket factors that change the woman's reservation wage (and hence their willingness to work). The estimated wage effects for childless women conflict with a simple labor supply model. Assuming that leisure is a normal good, a contemporaneous increase in male income should reduce employment while increases in the female wage should retard exits from employment. From the first column of the second block of estimates we see that exactly the opposite effects are obtained.

Reviewing the conception transitions, we see that the estimated income effects are positive: an increase in male income promotes fertility, with nearly identical effects for employed and nonemployed women. Estimated female wage effects are negative (except for the second birth of employed women) and statistically significant. For both male and female wages, the estimated effects are larger on the transition to the first birth. The estimated wage effects accord with those reported by Heckman and Walker (1990a). While the earlier study analyzed the fertility histories in the SFS, it did not model the employment process nor did it have access to individual wage or tax information. The current estimates reveal that the estimated wage effects are robust to disaggregation and the inclusion of taxes and refinement of the wage measures.

The woman's age increases the likelihood that she is working. For women without children, age operates on both the entry and exit decisions, though for women with children, only the latter effect is present. Thus as a woman ages she is more likely to enter and less likely to exit the employment state. After children appear in the household, age serves only to retain women in employment and has no effect on the re-entry rate. Among nonemployed women, an increase in age increases the probability of a conception, while among employed women, age has a small negative and statistically insignificant effect. For both employed and nonemployed women, Swedish women are increasingly less likely to have a second birth as they get older. Somewhat surprisingly, the estimated effects of the childrens' ages are, with one exception, small (only in the conception while employed transition). The estimated effect of the age at the first child is large and statistically significant. Apparently, child care responsibilities affect women's employment only upon the birth of the second child. The estimated effect of the first child's age is quantitatively small and not precisely estimated. In households with two children, the age of the youngest child affects the employment decisions of the woman. The estimates imply that a woman is more likely to work and less likely to leave employment as the youngest child grows older.

Estimated effects of the benefit variables are disappointing. Mirroring the result of the wage variables, supplemental variables exert little influence on transitions from employment to nonemployment.

For the conception transitions, with one exception, the estimated effects imply that increases in parental benefits *reduce* fertility and *increase* the time between births (the exception is the transition to the second conception by employed women for which the estimated effect is positive but negligible and not statistically significant). These results condition on a measure of recent attachment to the labor force, suggesting that the estimated negative effects are *not* the result that women more committed to the work place have higher attachment and thus qualify for higher benefits.[12] These estimates run counter to the expected effects from the theoretical framework

[12] The goal, of course, is to identify *exogenous* changes in benefits. Without a direct control for the employment process, the estimated effect of the benefit variable could be the spurious result of unobserved differences in labor market attachment of women--women with the strongest attachment may receive higher wages and will probably be entitled to the largest benefits, but may be the least likely to have a child.

which predicts that increases in childbirth benefits may increase the waiting time between births only through indirect effects operating through the entitlement process as women adjust their employment behavior to become eligible for greater benefits. Conditional on entitlement status, increases in the childbirth benefits unambiguously lower the shadow price of fertility and should have a positive or zero (for women not planning future births) effect. For conception decisions, it must be true that the changes in benefits are correlated with other factors not conducive to fertility that yields the estimated negative effects.[13] Indeed, I argue elsewhere that the increase in the female wage was so rapid during this period and that the incentives to become and remain employed dominated the pronatalistic effect of the increased in the childbirth benefits (Walker 1995). The 1981 Swedish Fertility Survey was fielded near the long-term trough in calendar birth rates. The period fertility rates increased in Sweden in the early 1980s and persisted until the early 1990s. If the environment is becoming increasingly conducive to childbirth, particularly with increased job security and with increased child care facilities, it becomes less costly to postpone childbearing. The swing in period fertility rates are consistent with a postponement and catch-up by these cohorts of Swedish women.

An exhaustive robustness analysis of these results has not been done, however, a similar pattern emerges if the controls for experience, mother's age and the ages of the children are deleted from the transitions. The qualitative features of the estimates are robust to the choice of female wage. In light of the narrowing of wage dispersion during the sample period, all reasonable methods for predicting female wages yield essentially the same time series profile for female wages and hence similar patterns of estimated female wage effects in the employment and

[13] An obvious conjecture is that the assumed exogeneity of parental benefits is wrong and that perhaps parental benefits were increased in response to declining (period) fertility rates. The stated intention of the benefit changes was to facilitate the market work by women (Statistics Sweden fact sheet, 1987; Einhorn and Logue 1989).

fertility processes. I have also estimated models without controlling for taxes and have obtained similar qualitative results on the algebraic sign of estimated parameters and their statistical significance. The magnitude of the estimated coefficients of course changes with the change in scale of the wage and benefit variables.

6.3 Summarizing Model Performance

This section applies predictive procedures to evaluate the performance of the estimated model along three different dimensions that capture different features of behavior and that have been selected to highlight the flexibility and the range of the approach. To isolate gross discrepancies in either the fertility or employment process, I evaluate the estimated model separately along each dimension. For the fertility process I consider the birth intervals and age at the second birth, whereas I summarize the employment process by the percent of the lifetime (until the survey date) employed. I then extend the evaluation and consider the employment and eligibility process before and after each birth.

Table 5 provides summary measures of marginal birth and employment processes. For each, the table reports sample values and predicted model quantities. The first column presents the proportion experiencing the event with the mean and standard deviation in columns two and three and quantiles in the remaining columns. The first set of rows in Table 5 reports values for the waiting time (recorded in months) to the first birth. The second block of rows reports values for the second birth while the third block summarizes model performance on the age at second birth (the sum of the two birth durations). The estimated model captures these measures of the fertility process reasonably well. For example, it exhibits small predictive error in the incidence of childbirth, for either of the two intervals or for the mean waiting time of completed spells. Predicted birth intervals are more dispersed than their observed sample counterparts. The latter observation also manifests itself in the quantities of the completed spells. The model predicts that 10 percent of all birth intervals will be 50 months or less, while the sample value is 69 months. At the upper end of the distribution, the model predicts that 95 percent of the completed intervals will be 228 months or less while in the sample the corresponding figure is only 212 months. A similar pattern occurs for the second birth interval, though with greater discrepancy in the interquartile range between the sample and model values than for the first interval. Prediction differences in the first and second intervals offset one another as the distribution of the age at second birth does not stochastically dominant the sample distribution--the predicted distribution is more skewed at the lower tail and less so at the upper tail (so the 95th quantile for the predicted model is *less* than the sample value).

The last block of rows in Table 5 compares the proportion of the lifetime in the employment state (since age 13 until the survey date) predicted by the estimated model and the observed sample value. The model predicts slightly higher attachment to the labor force (51.6 percent versus 50.9 percent evaluated at the means or 53.2 percent versus 51.1 percent using the medians). The estimated model exhibits slightly less variance and slightly under-predicts the magnitude of the group with the strongest attachment to the market (the top 5 percent in the sample spend 85 percent of the life in the labor market versus a predicted value of 82.4 percent).

Reviewing the estimated model in these dimensions suggests it fits the marginal processes of the bivariate processes reasonably well. This is a more stringent evaluation than it may first appear because almost all of the covariates in the model are dynamic and depend on the history of the process. Misspecification early in the lifecycle may accumulate through the lifecycle and make prediction of later events quite erroneous. Because discrepancies are uniform across the entire distribution, this apparently does not happen.

The solidaristic wage policy implies that the change in female wages is due to an exogenous source. Wage measures are highly correlated over the sample period and the distribution of wages is so narrow that education and experience have a limited role in explaining wage growth. For example, Hibbs (1990) reports that for blue-collar workers in 1970 only 138 percent separated the 2nd and 99th percentiles. The distribution in 1980 was even tighter, requiring only 82 percent to cover the gap between the 2nd to 99th percentile. During the 1970s, the median white collar salary is only 40 percent of the median industrial earnings and less than 18 percent of the top of the blue collar wage distribution (as measured by the 95th percentile). Hibbs argues that the compression of the wage distribution during the 1960s was as great as his measurement of the compression during the 1970s. One can show that experience and education are statistical determinants of wages, however, their practical significance (particularly that of experience) in explaining wage growth is minimal. The estimated model fits the distribution of births and the timing of completed birth intervals (through the first two parities where most of the population resides. Moreover, over a lifetime, the model captures a summary measure of the employment process as well. [14]

What are the qualitative features of the estimated model? How responsive are employment and fertility to changes in wage profiles and the generousness of the parental benefit system? Table 6 presents the results of two counterfactual simulations to answer these questions. In the first simulation I change the profile of female wages and in the second simulation I change the rules of the parental benefit system. For both simulations I fix their respect controls to their 1968 (real) value. Thus, the distribution of female wages does not vary over time but is fixed

[14] Some evidence of misspecification is shown by looking at the counting process associated with the employment process. The estimated model predicts more movement between employment states over the lifecycle than is observed in the sample. This evidence is suggestive, but without additional motivation for making the distribution of completed spells of employment an important dimension there is little reason to evaluate the model in this dimension. This highlights that the choice of dimensions used to evaluate an estimated model is completely context-specific.

equal to its distribution 1968. This means that counterfactual female wages are higher for periods before 1968 and lower after 1968. For the second simulation, I convert household income into 1968 kronor and allocate benefits according to the rules in place in 1968 and converted into 1976 kronor (as was used in the estimation). Since the estimated wage patterns are generally in agreement with theoretical predictions, I view the wage predictions as more interesting but report the parental benefit results for completeness.

The counterfactual female wage profile is less steep than is the observed profile. Approximately half of the sample experiences half of its observed reproductive history before 1968 and half after. Pivoting the female wage profile in 1968 keeps the present value of the wage stream approximately constant across the sample. If the new profile kept wealth exactly constant then observed changes in the fertility and employment processes would reflect only an intertemporal substitution effect. The large change in wealth and the near constancy of cohort fertility in Sweden during the twentieth century (see Walker 1995) implies that attention should center on timing behavior.

In the counterfactual female wage simulation, women face initially higher but less steeply sloped wage profiles. Consequently, as suggested by the theoretical model, they have less incentive to initiate the fertility process early in life (again, assuming wealth is constant). Eventually (after 1968), women face lower (and less steeply rising) real female wage levels which should promote fertility. Nulliparous women should be less likely to remain childless and women who delayed the birth of the first child have less incentive to postpone the second birth. While the estimated effects are small, this is exactly the pattern we see. The proportion of women remaining childless declines by 3.3 percentage points while the increase in the mean first birth interval is 5.3 months. The mean length of the second birth interval declines 1.7 months with a 1.9 percentage point increase in the proportion completing the second birth interval. There is little net effect on the woman's age at the second birth, three-tenths of a year or 3.6 months.

The last block of rows of Table 6 reports the effect of the counterfactual female wage profile on the percent of time employed. A change in the lifecycle profile of wages that leaves wealth constant should have no effect on a measure of total employment over the (reproductive) lifecycle. The counterfactual profile does not yield exactly constant lifetime wealth and generates a slight decrease in employment.

One aspect of the counterfactual simulation of the parental benefit system is interesting. Since many of the estimated coefficients on the benefit variables disagree with theoretical predictions, these results should be viewed with extreme caution. Indeed, as shown in the third panel of Table 6, fixing benefits at their 1968 level (and hence reducing them) *increases* the proportion of women with two children. The estimated model suggests that increasing benefits will reduce fertility. The counterfactual benefit simulation does reveal, however, the (unintended?) effect of changes in the benefit level on employment. The effect is small, but reductions in benefits reduce lifetime employment by 0.3 percent (about ½ month).

The preceding measures consider either the marginal fertility process or the marginal employment process, but many interesting policy and behavioral questions concern the bivariate process. Do extensions in benefits lengthen the time away from the market? Does their increasing generosity change the employment behavior between births? The bivariate process gives direct information on these issues.

Figures 4 and 5 present predicted and sample monthly employment proportions for an interval covering the first (Figure 4) and second (Figure 5) births. The interval spans twenty-four months before the birth and sixty months after the birth. In each figure, the employment proportions are disaggregated into five time periods--before 1961; 1961-65; 1966-70; 1971-75; and from 1976. The bulk of the observations occur after 1960. Before discussing the comparison of the predicted and sample proportions, the latter merits a few comments. Employment during the two years prior to the first birth (Figure 4) changes little during the sample period. During the last period, some exits from employment occur within a couple of months of the delivery, but the increase is slight. A striking feature of Figure 4 is the secular increase in employment following the first birth. While there is little change in employment for the first six months following the first birth, the latest period witnessed a rapid return to the workforce. During 1961-65, two years following a birth approximately 30 percent of the women worked compared to more than 75 percent for the post-1976 period. The employment pattern shifts perceptively in the early 1970s, concomitant with the tax reform mandating individual taxation. For the second birth (Figure 5), changes in employment are nearly as dramatic. During the sample period, pre- and post-birth employment rose at nearly identical rates. For example, in 1966-70, approximately 30 percent of women worked the year prior to giving birth. By the last period, that proportion had doubled to 60 percent. Employment following the second birth is less than for women with one child, but the percentage increase in employment has been equally strong. In the late 1960s, approximately 25 percent of women worked twenty-four months after their second birth. A decade later, the percentage rose to 50 percent. The sample employment proportions in Figures 4 and 5 reveal a strong and increasing connection to the labor market by Swedish women with children.

Comparisons of the predicted employment proportions from the estimated model with the sample employment proportions are equally informative. Figure 4 reveals that in all subperiods the model under- estimates employment before the birth and over-estimates employment after the birth. Since 1976, the model and sample employment rates are quite similar following the birth. Yet, in this and other subperiods, the model predicts that a quarter of Swedish women will remain employed (at work) during the month of the birth while the observed sample proportion is only 5 percent. In no subperiod does the estimated model predict the pre-birth employment history well. Predictions for the 1971-75 subperiod are particularly bad (off by 25 percentage points or 50 percent). While the discrepancies between the estimated model and sample proportions are less extreme in the last subperiod it is difficult to argue the discrepancies are small. In describing employment around the first birth, the estimate model captures the general secular increase in employment (both pre- and post-birth) but it misses important aspects of the changing pattern and exhibits persistent errors in the level of employment.

Model predictions of employment around the second birth fares somewhat worse (Figure 5). The model over-predicts employment in months prior to a birth during the early subperiods but under-estimates employment prior to a birth in the last subperiod. (The first subperiod contains only a veritable handful of second births.) Once again, for this parity the model over-estimates the proportion of women who remain employed during the birth month. More telling, however, is the model's inability to accurately predict employment in months following the second birth. The model substantially overestimates employment following the second birth in all subperiods and unlike predictions for the first birth, the predictions do not become more accurate in the last subperiod. The estimated model exhibits the smallest discrepancy with sample values during the 1966-70 subperiod when women either did not return to work or had long absences from the labor market (sixty months after the second birth only 35 percent are employed). The estimated model captures little of secular change in employment surrounding the second birth; as predicted employment proportions both before and after the birth are quite similar in each of the subperiods.

The value of the bivariate predictive measures are clear. The estimated model performs well along dimensions of the marginal processes, but performs poorly in an important dimension of the bivariate process. From a methodological standpoint this experience suggests that the empirical power of predictive procedures for detecting model misspecification increases in the number of behavioral processes needed to define the predictive dimension. This example also illustrates that predictive procedures *complement* conventional model specification tests. The uncomfortably large number of discrepancies in the estimated coefficients and their anticipated values, especially the negative and statistically significant estimated coefficients on the benefit variables in the conception transitions is strong evidence of model misspecification. Believing the model is misspecified, the value of the predictive procedures is to help determine *where* the model misspecification occurs. Importantly, the predictive procedures provide this diagnostic information in terms of the underlying behavioral context. The message from Figures 4 and 5 is that the model over estimates the value of employment following a birth, especially the second birth. Three avenues for future research are suggested.

The current binary representation of the employment process may be too restrictive and by restricting the employment state to full-employment may overestimate the value of employment following a birth. As is well-known, nearly all of the increase in women's employment during the 1970s occurred through the expansion of the local public sector which offered flexible working schedules. This evidence suggests that future work should explore a richer definition of the employment process, ideally expanding the state space to include full and part-time employment. Expanding the state space will require a change in the modeling strategy to control the number of estimated parameters. Perhaps a richer description of the state space will permit restrictions on the hazard coefficients across transitions. For example, it may not be necessary to separately model each employment transition by birth parity. This issue can also be fruitfully explored in future work.

Second, in response to the large increase in women's employment, Sweden committed in 1975 to a major expansion of publicly subsidized child care facilities. Nevertheless, by the end of the sample period at best only the major urban areas had adequate facilities. Through most of the sample period there was substantial variation in the availability and cost of child care facing Swedish women. By failing to incorporate child care costs, the current model overestimates the value of employment following a birth. Hence, explicit recognition of the availability and cost of child care may improve model performance.

Finally, recall that in the model with perfect certainty the shadow price of employment equals $\pi_t^e = w_t + \delta b_{t+1}(\eta w_{t+1} - g_0)$. Introducing uncertainty and assuming that future fertility is the only source of uncertainty, the expected shadow price of fertility equals $w_t + \delta(\eta w_{t+1} - g_0)P_t(b_{t+1}=1)$, where $P_t(b_{t+1}=1)$ represents the probability of a birth in period t+1 conditional on information in period t. Without formally modeling individuals' expectations, the current specification of the supplemental benefit variable implicitly sets $P_t(b_{t+1}=1) = 1$. Even for individuals planning to have another child, only as they approach their desired conception date does the probability approach one. This source of misspecification affects all parities but is especially detrimental for the higher parities. A variety of estimation schemes may be pursued to incorporate this aspect of behavior.[15]

7.0 Summary

This paper formulates and estimates a bivariate waiting time process to describe lifecycle fertility and employment behavior for two cohorts of respondents of the 1981 Swedish Fertility Survey. Interest in this application is both substantive and methodological. Sweden has an extensive set of childbirth benefits that link benefit payments to the woman's employment history. The substantive focus is to isolate the effects of these programs on lifecycle fertility and

[15] The most ambitious would be estimate a dynamic structural model of the woman's choice process, championed most notably by Wolpin (1984).

female employment decisions. Complicating the analysis is that other programs and especially the economic environment (as summarized by female wages) were also changing. I develop a simple model of lifecycle decision making to derive shadow prices of employment and fertility that summarize the effect of both the changing economic environment and changes in parental benefits. Knowledge of the components of the shadow prices is used to specify the covariates of the hazard functions. The estimation results are mixed. The estimated wage effects are generally consistent with theoretical predictions, however, the estimated effect of the benefits on fertility decisions are not. Resolution of the effects of the parental benefits awaits future analysis. However, several conjectures on the probable source of model misspecification provide avenues for future research.

While multistate hazard models provide a powerful analytical device for investigating lifecycle behavior, little is currently known on their formulation and implementation. The primary methodological contribution of this paper is the application of procedures to aid in model evaluation and selection for modeling a complicated multistate process. These procedures provide valuable diagnostic information on the qualitative and quantitative characteristics of the estimated model. Estimated coefficients are important, but in these nonlinear and recursive models the only way to understand process dynamics is to use predictive procedures to shift the model evaluation process into the observed dimensions of the process. As illustrated by the application, identifying the source of model misspecification is particularly valuable for formulating future avenues of research.

Table 1
Descriptive Statistics by Parity
Eligibility at Conception, Proportion of Conception Interval Employed, and Length of Conception Interval
Women Born 1941-1949

First Interval	Number	Proportion Eligible	Proportion of Interval Employed	Mean Length of Conception Interval	Standard Error of Mean Interval
≤ 1960	56	.732	.434	53.7	1.8
1961-65	469	.789	.465	81.1	1.2
1966-70	621	.829	.468	111.8	1.4
1971-75	421	.874	.489	152.4	1.5
≥ 1976	124	.935	.532	204.7	3.1
Second Interval					
≤ 1960	3	.333	.158	13.3	3.0
1961-65	155	.387	.225	22.8	1.0
1966-70	428	.425	.249	28.3	0.8
1971-75	486	.593	.402	38.1	1.1
≥ 1976	248	.742	.537	45.8	2.0

Table 2
Definition of Variables Utilized in Analysis

Variable	Description
Male Income	Predicted after-tax male income expressed in 1976 Kronor. This variable is zero if the woman is single (not married and not cohabiting with a male). Changes annually and with any change in household status. Expressed in thousands of Kronor.
Female wage	Individual specific predicted after-tax female wage expressed in 1976 Kronor. Changes annually. Expressed in tens of Kronor. (See Appendix B.)
Total Benefits	After-tax value of parental benefits equal to the sum of guaranteed and (if eligible) supplemental benefits, $g(e_{t-1})$. Changes with a change in any component required to compute benefits (e.g., eligibility status, wages). Denominated in 1976 Kronor and expressed in units of ten-thousand Kronor.
Supp Benefits	Supplemental benefits equal to the difference between earnings related and guaranteed benefits, $\eta w_t^* - g_0$. Changes with a change in any component required to compute benefits. Denominated in 1976 Kronor and expressed in units of ten-thousand kronor.
FPB	Defined in the month of conception, a time-invariant measure of the parental benefits the respondent is entitled to receive at the birth of the next child. Denominated in 1976 Kronor and expressed in units of ten-thousand kronor.
Prop employed	Proportion of the previous twenty four months spent employed.
Age	Respondent's age, equal to the number of months since age 13 divided by 100.
Age of 1st Chd	Age of first child, measured in months divided by 100.
Age of 2nd Chd	Age of second child, measured in months divided by 100.
Dur 1-6 months	An indicator variable = 1 during the first half-year following the birth of a child; 0 otherwise.
Dur 7-12 months	An indicator variable = 1 during the second half-year following the birth of a child; 0 otherwise.
Dur 13-18 months	An indicator variable = 1 during the half-year following the birth of a child; 0 otherwise.

Table 3
Transition Counts and Mean Durations (in months)

	Destination State							
	Not Pregnant						Pregnant	
Initial State	Not Employed Parity 0	Not Employed Parity 1	Not Employed Parity 2	Employed Parity 0	Employed Parity 1	Employed Parity 2	Not Employed	Employed
Not Pregnant								
Not Employed Parity 0	33 47.15			2760 40.08			292 40.67	
Not Employed Parity 1		76 48.64			1131 14.52			
Not Employed Parity 2			273 57.26			947 30.46	257 31.96	
Employed Parity 0	1166 33.53			233 120.33				1345 54.74
Employed Parity 1		277 31.06			288 71.55			637 26.45
Employed Parity 2			250 29.59			612 54.01		151 30.47
Pregnant								
Not Employed		1539 3.97	1206 6.61				11 4.18	110 3.17
Employed					79 10	66 10.05	2115 7.92	

The top entry in each cell records the number of transitions with the mean duration, in months, recorded beneath it.

Table 4
Estimate of Joint Fertility and Employment Process

Transition	Parity 0		Parity 1		Parity 2	
Variable	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error
Not Employed to Employed						
Intercept	.255	.066	.176	.190	-.564	.185
Male Income	.071	.014	-.171	.020	-.145	.021
Female Wage	.200	.103	.828	.116	.484	.135
Age	.594	.073	-.079	.111	.003	.126
Age of 1st Chd			-.099	.159	.116	.164
Age of 2nd Chd					.454	.193
Prop Emp			.889	.187	2.681	.184
Total Benefits						
Supp Benefits	.412	.179	.334	.210	-1.546	.204
FPB			-.318	.307	.870	.151
FPB* Dur 1-6 mo			-.356	.357		
FPB* Dur 7-12 mo			1.320	.333		
FPB*Dur 13-18mo			1.619	.457		
Dur 1-6 months			.654	.210		
Dur 7-12 months			.323	.204		
Dur 13-18months			-.495	.278		
Employed to Not Employed						
Intercept	-.606	.101	.631	.453	-.196	.551
Male Income	-.050	.021	.057	.039	.073	.058
Female Wage	1.172	.126	.112	.328	.671	.311
Age	-.749	.096	-.699	.228	-.410	.256
Age of 1st Chd			-.168	.228	.100	.277
Age of 2nd Chd					-.663	.312
Prop Emp			-.105	.372	.225	.381
Supp Benefits	.133	.200	.371	.337	-.161	.270
FPB			-.443	.324	-1.246	.295

Transition	Parity 0		Parity 1		Parity 2	
Variable	Estimate	Std Error	Estimate	Std Error	Estimate	Std Error
<u>Conception while Not Employed</u>						
Intercept	-.670	.183	1.407	.173		
Male Income	.623	.038	.261	.058		
Female Wage	-2.400	.214	-.535	.209		
Age	1.716	.168	-.284	.152		
Age of 1st Chd			-.261	.207		
Prop Emp			-1.538	.209		
Total Benefits	-1.451	.321	-.817	.266		
<u>Conception while Employed</u>						
Intercept	.574	.104	-.116	.301		
Male Income	.519	.019	.361	.046		
Female Wage	-1.133	.127	.105	.216		
Age	-.145	.084	-.547	.148		
Age of 1st Chd			-1.280	.171		
Prop Emp			.877	.249		
Total Benefits	-.119	.150	.020	.172		
loglike	-3149.9		-370.2		-498.1	

Table 5
Moments and Quantiles of Birth Intervals, Age at Second Birth, and Proportion of Lifecycle Employed, Sample and Model

	Moments			Quantiles						
	Prop	Mean	Std	5	10	25	50	75	90	95
First Birth (months)										
Sample	86.2	127.6	48.1	58	69	91	124	157	194	212
Model	87.7	128.0	57.7	34	50	89	127	168	207	228
Second Birth (months)										
Sample	.671	43.4	24.1	18	21	28	37	52	72	92
Model	.678	45.1	32.6	11	12	20	36	62	89	109
Age at Second Birth (years)										
Sample	.671	26.5	3.75	20.7	21.6	23.7	26.3	29.3	31.5	32.8
Model	.678	26.0	3.88	19.2	20.8	23.4	26.2	28.8	30.8	31.6
Proportion of Lifetime in Labor Market (%)										
Sample		50.9	21.1	15.9	22.6	35.7	51.1	67.0	80.1	85.0
Model		51.6	20.3	15.0	23.4	37.7	53.2	67.1	77.2	82.4

Table 6
Counterfactual Simulations
Moments and Quantiles of Birth Intervals, Age at Second Birth, and Proportion of Lifecycle Employed

	Moments			Quantile						
	Prop	Mean	Std	5	10	25	50	75	90	95
First Birth (months)										
Model	87.7	128.0	57.7	34	50	89	127	168	207	228
Wages	91.0	133.1	55.8	38	57	97	131	170	207	228
MB	89.8	132.2	57.6	36	54	92	131	171	209	230
Second Birth (months)										
Model	.678	45.1	32.6	11	12	20	36	62	89	109
Wages	.697	43.4	31.0	11	12	19	35	59	86	103
MB	.713	43.9	31.8	11	13	19	35	60	87	106
Age at Second Birth (years)										
Model	.678	26.0	3.88	19.2	20.8	23.4	26.2	28.8	30.8	31.6
Wages	.697	26.3	3.81	19.7	21.4	23.8	26.4	29.9	30.9	31.9
MB	.713	26.4	3.93	19.4	21.0	23.8	26.5	29.2	31.2	32.1
Proportion of Lifetime in Labor Market (%)										
Model		51.6	20.3	15.0	23.4	37.7	53.2	67.1	77.2	82.4
Wages		51.1	20.7	13.7	22.1	36.9	52.7	66.9	77.2	82.3
MB		50.8	20.4	14.2	22.4	36.8	52.2	66.3	76.7	81.8

Figure 1

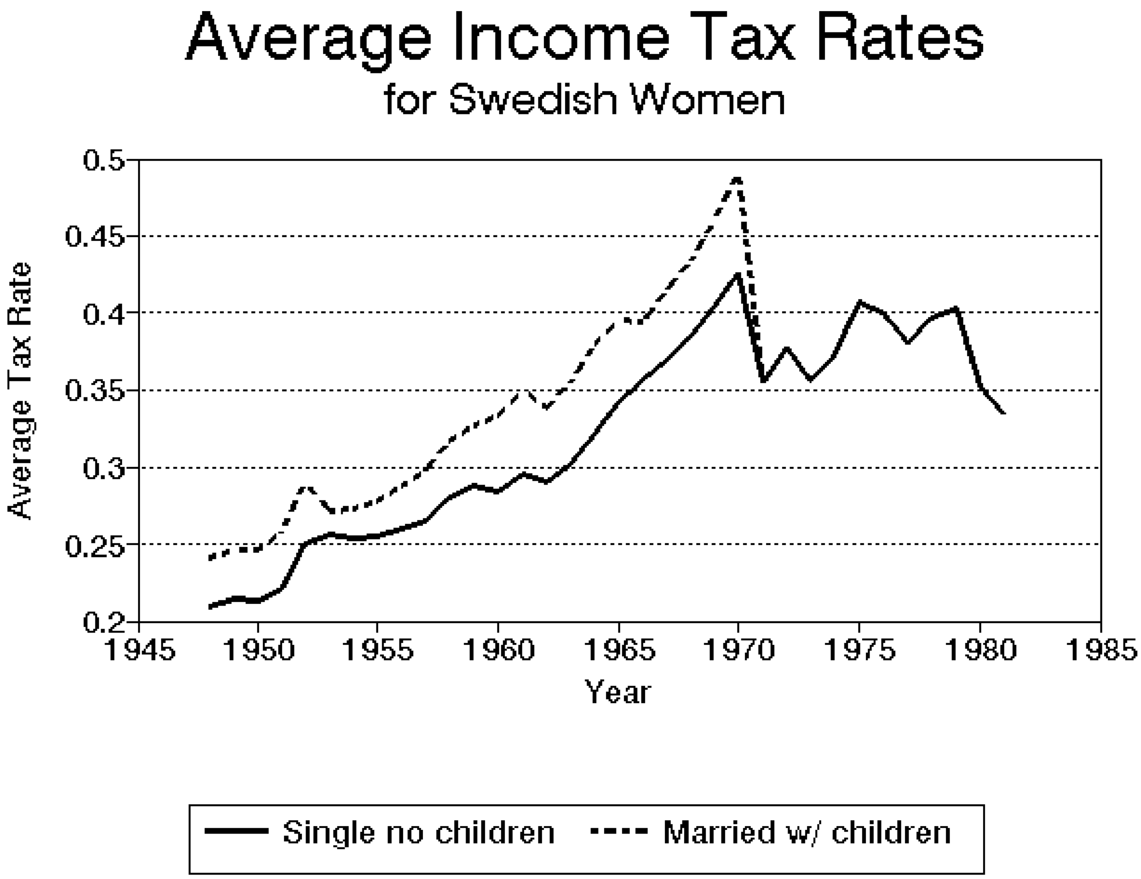

Average Income Tax Rates
for Swedish Women
Average Tax Rate
0.5
0.45
0.4
0.35
0.3
0.25
0.2
1945
1950
1955
1960
1965
1970
1975
1980
1985
Year
Single no children
Married w/ children

Figure 2
State Space of the Multistate Duration Model

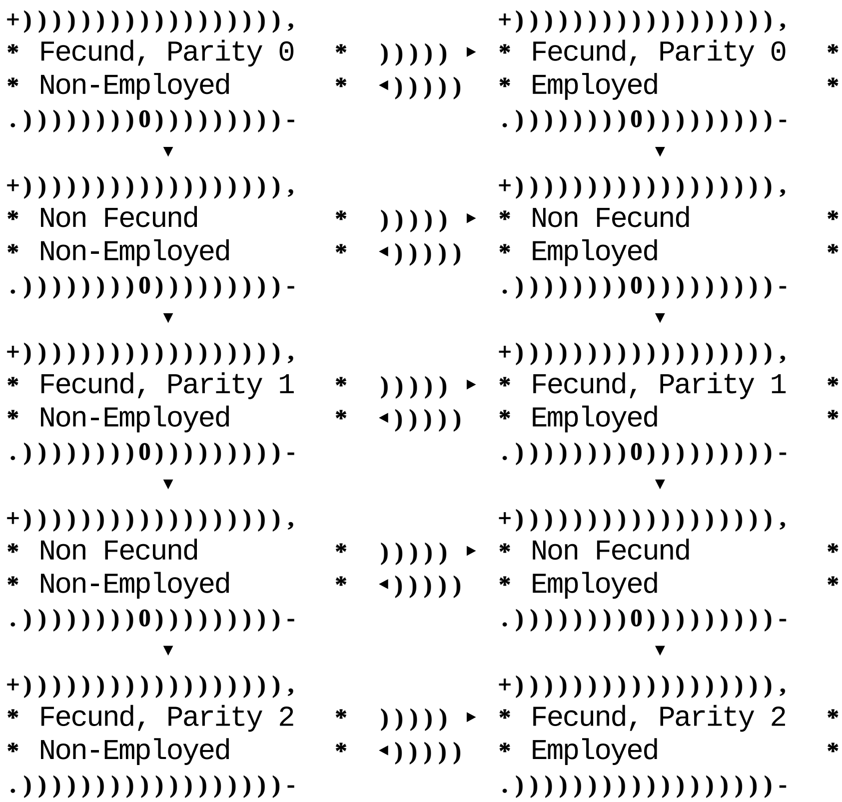


Figure 3

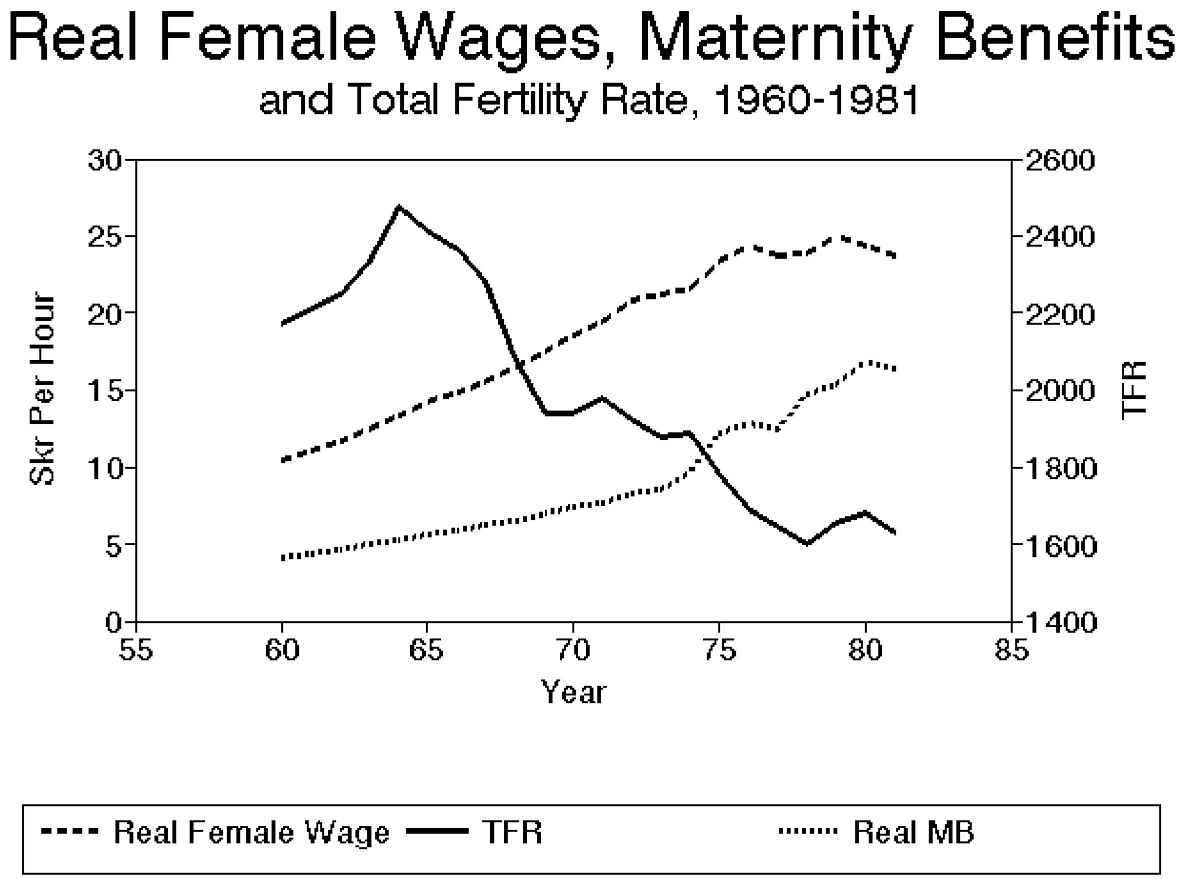

Real Female Wages, Maternity Benefits
and Total Fertility Rate, 1960-1981
30
25
20
15
10
5
0
2600
2400
2200
2000
1800
1600
1400
Skr Per Hour
TFR
55
60
65
70
75
80
85
Year
Real Female Wage
TFR
Real MB

Figure 4
Proportion Employed First Birth
Sample and Model Rates

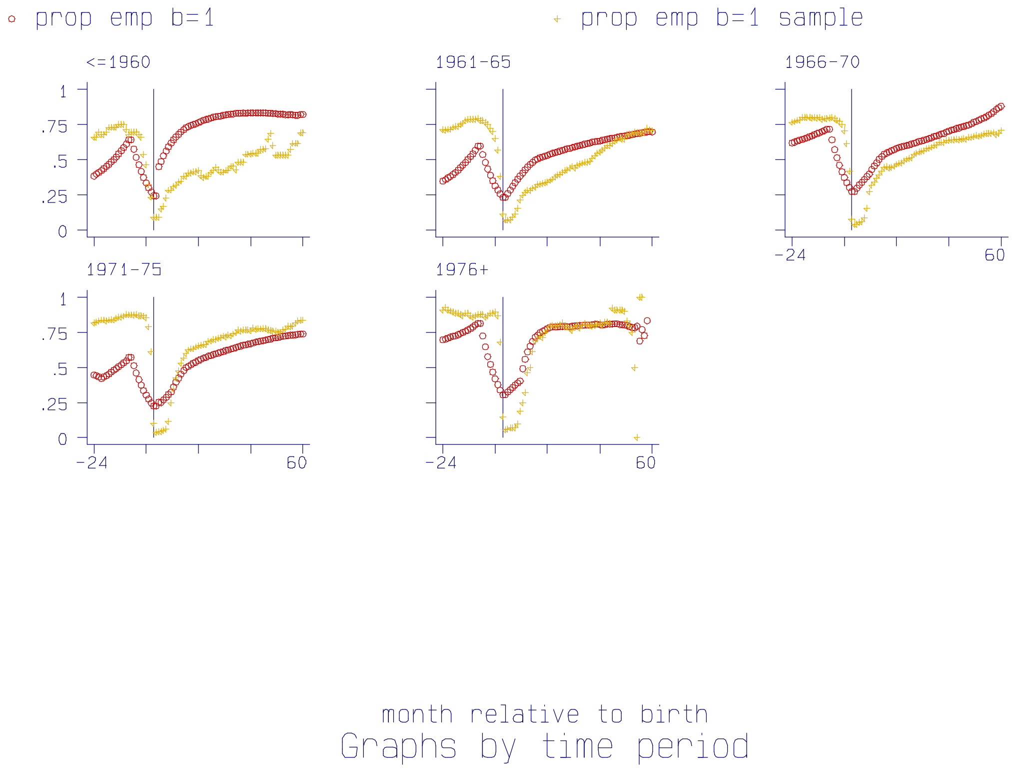
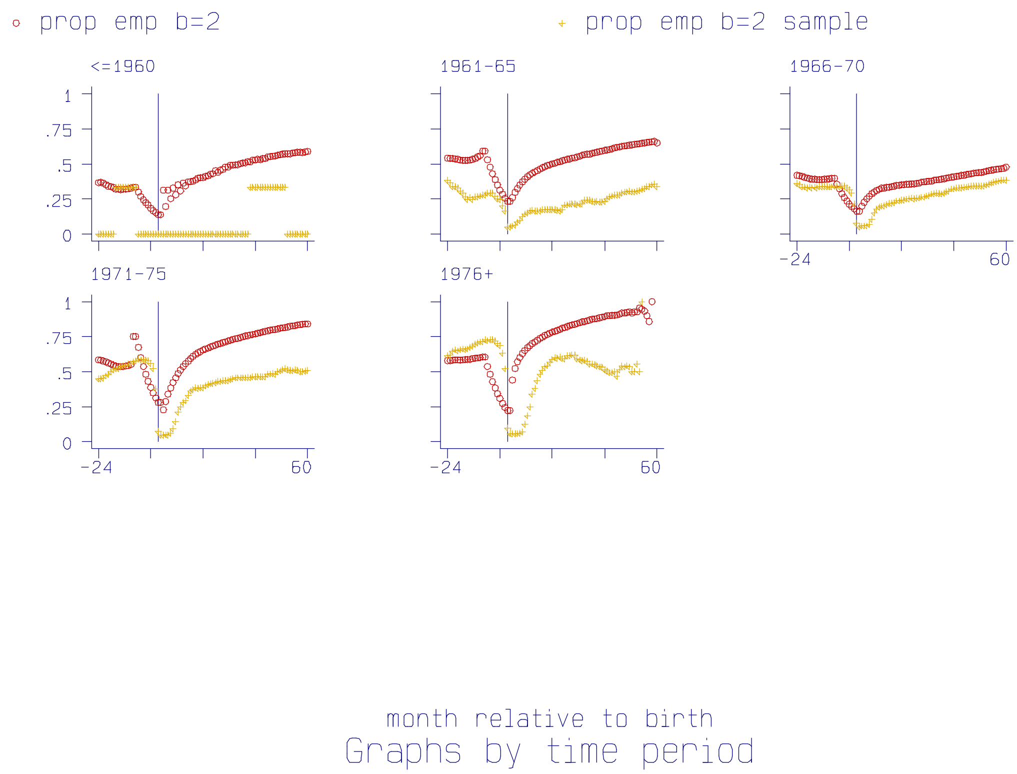


Figure 5
Proportion Employed Second Birth
Sample and Model Rates



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Appendix A
Maternity and Parental Benefit Programs 1955-1980

Sweden has long been known for its generous maternity, and since 1974, parental benefit plans. This appendix summarizes the various changes in the coverage and benefits occurring during the sample period.

1955-1963

With the introduction of national health insurance, a maternity benefit program replaced the existing programs offered by voluntary insurance societies. At childbirth each woman is entitled to a cash allowance of 270 kr. A woman who was gainfully employed for not less than 270 days before (the expected date of) childbirth on an annual income of at least 2600 kr for sickness benefits was also entitled to a supplementary sickness allowance. The supplemental allowance was paid for continuous periods that the woman was away from employment, to a maximum duration of 180 days. Supplemental maternity benefits vary with earned income; the benefit schedule is listed in Table A-1. Cash maternity benefits are not subject to State (national) or local income tax.

1964-1967

As of January, 1964, women were entitled to receive a basic cash maternity allowance of 900 kr at child birth; in the event of twins, the allowance was increased by 450 kr per child. Supplementary benefit levels increased as per Table A-2. Program eligibility and other rules remained as in 1956.

1968-1973

As of January, 1968, women were entitled to receive a basic cash maternity allowance of 1080 kr at child birth; in the event of twins, the allowance increased by 540 kr per child. 300 kr of allowance could be obtained no more than 120 days before the (expected date of) birth of the child. Women gainfully employed at least 270 consecutive days before childbirth on an annual income of at least 2600 kr were entitled to a supplemental maternity allowance. The supplemental benefits could be paid, no sooner than 60 days before the expected date of birth for a maximum of 180 days. As a rule, the amount of the maternity allowance payable before the birth of the child was paid from the date of the application. From the 30th day after birth, the maternity allowance was paid only if the mother had the child in her care, or if because of illness she was prevented from taking care of her child.

Supplementary allowances were graduated with income according to the schedule in Table A-2.

1974-1980

As of January, 1974, the existing maternity benefit program was abolished and replaced with the parental benefit program. Now, the father as well as the mother is eligible to a cash benefit to remain home and care for a child. Furthermore, the parental benefit program was fully incorporated into the cash sickness insurance program. The general rules regarding eligibility of earnings-related sickness benefits apply to the parental benefit program. Parental benefits, like sickness benefits, are considered taxable income and contribute to publicly funded pension schemes.

Parents are eligible to receive either the guaranteed minimum benefit or 90% of the their labor market earnings for a prescribed number of days. The maximum benefit spell and guaranteed minimum benefit changed several times since 1974. These changes are summarized in Table A-4. In 1974, parental benefits were 180 days with a guaranteed benefit of 25 kr per day. In 1975, coverage was extended to 210 days (7 months) and the minimum benefit raised to 32 kr per day. Basic parental benefits must be taken within 270 days of the birth, starting no more than 60 days before the expected date of birth. In 1978, special parental benefits were introduced. Basic parental benefits were restricted to 180 days. Special benefits could be received for 90 additional days; the first 60 days are covered at the individual's sickness benefit rate (i.e. 90% of earnings) and the remaining 30 days at the guaranteed minimum rate (32 kr per day). Special benefits could be used any time before the child's eighth birthday.

Table A-1

Daily Cash (kr) Maternity Allowances 1955-1963
(Maximum benefit period = 180 days)

Earnings Range	Supplemental	Total
1800 - 2600	0	1.5
2601 - 3400	1	2.5
3401 - 4200	2	3.5
4201 - 5000	3	4.5
5001 - 5800	4	5.5
5801 - 6800	5	6.5
6801 - 8400	7	7.5
8401 - 10200	9	10.5
10201 - 12000	11	12.5
12001 - 14000	13	14.5
14001 - 16000	15	16.5
16001 -	17	18.5

Sources:
1. Korpi, Tomas, letters to Professor V. Joseph Hotz at the University of Chicago, October, 1985.
2. Olsen (1986).

Table A-2

Daily Cash (kr) Maternity Allowances 1964-1967
(Maximum benefit period = 180 days)

Earnings Range	Supplemental	Total
1800 - 2600	0	5
2601 - 3400	1	6
3401 - 4200	2	7
4201 - 5000	3	8
5001 - 5800	4	9
5801 - 6800	5	10
6801 - 8400	7	12
8401 - 10200	9	14
10201 - 12000	11	16
12001 - 14000	13	18
14001 - 16000	15	20
16001 - 18000	17	22
18001 - 21000	20	25
21001 -	23	28

Source: *Social Benefits in Sweden, 1964.*(The Swedish Institute, 1964)

Table A-3

Daily Cash (kr) Maternity Allowances 1968-1973
(Maximum benefit period = 180 days)

Earnings Range	Supplemental	Total
1800 - 2600	0	6
2601 - 3400	1	7
3401 - 4200	2	8
4201 - 5000	3	9
5001 - 5800	4	10
5801 - 6800	6	12
6801 - 8400	8	14
8401 - 10200	10	16
10201 - 12000	13	19
12001 - 14000	16	22
14001 - 16000	19	25
16001 - 18000	22	28
18001 - 21000	25	31
21001 - 24000	28	34
24001 - 27000	31	37
27001 - 30000	34	40
30001 - 33000	37	43
33001 - 36000	40	46
36001 - 39000	43	49
39001 -	46	52

Source: *Social Benefits in Sweden, 1968.*(The Swedish Institute, 1968)

Table A-4

Parental Benefits 1974-1980

Date	Program Description
January, 1974	Parental Benefit replaces maternity allowances. Maximum coverage = 180 days, guaranteed minimum benefit = 25 kr/day
	Temporary Child Care Benefits introduced. Parents have the right to receive their sickness benefit for up to 10 days to remain home to care for a sick child under the age 12.
January, 1975	Maximum coverage extended to 210 days. Guaranteed minimum benefit increased to 32 kr/day.
January, 1977	Temporary child care benefits extended to 12 days per annum for families with one child, 15 days to families with two children and 18 days for families with three or more children.
January, 1978	Basic benefit coverage reduced to 180 days. Special benefits introduced, maximum 90 days of which 60 may be compensated at the sickness benefit rate (90% of insured earnings) and the remaining 30 days at the guaranteed minimum benefit of 32 kr/day.
January, 1980	Pregnancy benefits. Pregnant women unable to perform their jobs involving strenuous labor may receive sickness insurance rate for up to 50 days before the expected date of the child. Employers must first attempt to place the worker in less strenuous work.
	Temporary Child Care Benefits extended up to 60 days per child per year, for children under the age of 10. Situations qualifying for compensation are illness or infection sustained by the child or the person normally caring for it and visits to preventive child care institutions.
September 1, 1980	Special benefits extended to 180 days. The first 90 may be compensated at the sickness benefit rate, the remaining 90 days at the guaranteed minimum rate. Guaranteed minimum rate increased to 37 kr/day.

Sources:
1. *Social Insurance in Sweden 1973/74* (The Swedish Institute, 1973, Alan Golderson and Eva Marshall, translators.)
2. Olsen (1986).

Appendix B

Predicting Female Wages and Estimating the Tax Function

In this appendix I discuss procedures used to predict female wages and the estimation of the tax function, the latter used to determine the average tax rate. Information on the economic condition of households was not obtained by the Swedish Fertility Survey of 1981. To augment these data, our project obtained individual tax returns for the respondents and their partners for the period 1968-1980. Irene Andersson of The University of Gothenborg played a primary role in working with the staff at Statistics Sweden to obtain and document the tax files. The tax reform of 1971 which made the individual the basic tax unit simplified the search within the national tax records and increased our ability to find the returns for all women.

Information obtained for each year depends exclusively on what was retained in machine-readable form by Statistics Sweden. This varied from year to year, with the amount of information increasing for the more recent years. Income by source (e.g., from employment, property, business, etc.) and type (earned [A-income] and unearned [B]) as well as national and local taxes paid are reported each year. Limited information on deductions and credits is available for the most recent years as is limited information on the receipt of social insurance benefits. Gross earnings from employment (a consistent measure of employment income across years) and annual hours of work from the fertility survey are utilized to calculate an hourly wage.

The predicted female wage is used to backcast wages before 1968, to fill-in wages for nonworking women and to correct for measurement errors in the calculated wage rates. As mentioned in the text, although annual selection corrections are statistically significant their quantitative importance is small (on the order of about 1-2 percent) and do not affect the time series properties of the predicted wage profiles. Consequently I have concentrated on dealing with measurement error in the calculated wages. Obtaining a valid and informative wage profile for each woman, in the presence of severe measurement error, is a nontrivial task.

Gross evidence of measurement error is easily obtained. Table B-1 reports descriptive statistics for the relative wage defined as the ratio of individual wages estimated from combining earnings information from tax returns with annual hours of work information from the Swedish Fertility Survey divided by the annual age- and gender-specific wage for shop assistants developed by Tasiran and Gustafsson (1990). Scaling the individual wages by an aggregate wage measure provides an approximate adjustment for inflation and gender specific wage growth over the sample period. Measurement error will likely manifest itself as individual specific outliers (that is, as large deviations from the individual's trend in wages). Since the mean is sensitive to outliers while the median is not, comparing changes in these statistics to different trimming rules (i.e., deleting certain observations) provides direct evidence on the influence of outliers and on the extent of measurement errors.

The five blocks of Table B-1 report statistics on the relative wage distribution for several levels of trimming. The first block of rows (labeled "All") reports the untrimmed relative wage distribution. For each individual, the median, mean, and standard deviation of their relative wage sequence are calculated across calendar years and these statistics are then averaged across individuals. For example, the average median relative wage in the sample of all respondents in the survey[16] is 1.166, the average mean relative wage is 1.368, with the average number of observations per individual of 7.378. The influence of outliers is quite noticeable in the untrimmed relative wage distribution as the mean relative wage is 20 percent larger than the average median.

The second block in Table B-1 reports statistics on the relative wage distribution after removing all wages observations in years in which the respondent had a birth. This has a large effect on reducing the average standard deviation. Indeed, taken at face value (assuming no measurement error) the decline in the mean relative wages attributed to eliminating the birth year

[16] There are 4,257 respondents to the Swedish Fertility Survey, including individuals from the youngest birth cohort (women born 1956-1960). Most of the 200 individuals without wages never reported income from employment in their tax returns.

observations means that fertility increases wages 28 percent (!).[17] The next two blocks report, respectively, the effect of removing birth years and the maximum relative wage, and birth years and the minimum relative wage for each individual. The summary statistics in these blocks reveal (not surprisingly) that the relative wage distribution is sensitive to the maximum observations and not the minimum observation. Once birth years and each individual's maximum relative wage were deleted, the difference between the mean and median is one-half a percentage point. For this distribution, the average standard deviation is about 1/3 that of the untrimmed distribution. The last block of statistics reports deletion of birth years and symmetric trimming of the minimum and maximum relative wage observations. Again the difference in mean and median relative wage measures is less than a percentage point. The mean standard deviation is slightly more than one-quarter of the quantity of the untrimmed distribution.

To avoid the problems associated with measurement error documented in Table B-1, the regression analysis excludes birth years trims 5 percent from the top and bottom of the relative wage distribution. Table B-2 reports the log wage regression estimated on this sample and used to predict female wages. Log wages depend on education, the log shop-assistant wage plus cohort dummies and interaction terms of the cohort dummies and the log shop-assistant wage. Inclusion of the shop-assistant wage proxies for aggregate demand conditions that raise and lower all wages. It is strongly correlated with the widely reported female manufacturing wage (the correlation coefficient between the series varies from .9 to .96 depending on the birth cohort). Wage compression during the 1970s means that the time series properties of all aggregate wages measures will be quite similar. Recognizing the panel nature of the wage data, I estimate a random effects model. The variance of the individual component is small (about 7.5 percent) with little evidence of endogeneity of the individual components (the p-value on the test statistic of equality between the fixed and random effect estimates is .1093).

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[17] Another troubling observation is that mean wage rates are higher for part-time workers than for full-time workers. Also, a review of individual wage profiles reveals substantial year-to-year variability, particularly for women with intermittent labor force behavior.

The availability of individual level tax returns reporting earnings and taxes paid permitted a simple empirical procedure by which to include the complex and ever changing Swedish income tax system into the analysis. It is easiest to think about the estimation procedure in two steps. In the first step, the respondent's tax liability was calculated using the respondent's reported earnings from employment, the average local tax rate and the national tax schedules. Using data for the years 1971-80, the calculated tax liability was regressed on total income taxes actually paid by the respondent. Several alternative regression specifications were estimated. Table B-3 reports the estimates of the selected estimated tax function. Adding additional covariates to the quadratic specification improved the fit of the estimated tax function only slightly (as measured by the coefficient of determination).

Data limitations restricted the estimation procedure to the period 1971-1980. 1971 is the first year of uniform tax schedules, independent of marital status and the number of children, and it is also the first year of mandatory separate filing of returns. Predicting tax liability in years before 1971 uses data from 1971 on, to extrapolate across a regime-change in tax policy. However, the predicted average tax rates implied by the estimated tax function for the pre-1971 period compare favorably with those reported in Burtless (1987). One reason for this encouraging result is that in 1971 respondents of the Swedish Fertility Survey are young--the oldest respondent is 35 years old. Income from employment is the primary income source and the women have accumulated few assets. Under these circumstances, the individual's tax liability will deviate little from the official tax schedule.

Table B-1

The Effect of Trimming on Individual Relative Wages (RW)
(Relative Wages = Wage/Female Shop Assistant Wage)

statistic	Cases	Mean	Std Dev	Min	Max
All Cases					
Years/Case	4257	7.378	3.877	0	13
Median RW	4069	1.166	0.538	0.017	12.444
Mean RW	4069	1.368	0.810	0.02	16.654
SD RW	4069	0.748	1.276	0	31.852
Remove Births					
Years/Case	4257	6.771	3.689	0	13
Median RW	4055	1.142	0.519	0.017	14.444
Mean RW	4055	1.264	0.803	0.02	21.925
SD RW	4055	0.546	1.193	0	36.786
Remove Births and Maximum					
Years/Case	4257	5.818	3.607	0	12
Median RW	3895	1.057	0.408	0.015	9.176
Mean RW	3895	1.062	0.421	0.015	9.176
SD RW	3895	0.245	0.270	0.000	4.952
Remove Births and Minimum					
Years/Case	4257	5.818	3.607	0	12
Median RW	3895	1.262	0.936	0.022	32.616
Mean RW	3895	1.389	1.067	0.025	32.616
SD RW	3895	0.521	1.371	0.000	44.952
Remove Births, Maximum and Minimum					
Years/Case	4257	4.930	3.479	0	11
Median RW	3659	1.133	0.417	0.017	8.189
Mean RW	3659	1.150	0.432	0.020	8.189
SD RW	3659	0.197	0.271	0.000	5.900

The relative wage is defined as the individual's wage calculated using information from annual tax returns and hours of work reported in the SFS divided by the age- (and year-) specific wage for female shop assistants.

Table B-2

Log Wage Regression of Real Female Wages, 1968-1980
Model: $\ln w_{it} = x_{it}\beta + u_{it}$, with $u_{it} = \alpha_i + \epsilon_{it}$

Variable	Estimate	Stderr	Covariate Mean
Intercept	1.0133	.1390	----
Years of Education	.0317	.0018	12.0378
Log Shop Wage	.2159	.0532	2.8450
Born 1941-45	-.1995	.1524	.2934
Born 1946-50	-.7660	.1431	.2926
Born 1951-56	-1.5856	.1444	.2614
Born 1941-45 * Log Shop wage	.1120	.0523	.8423
Born 1946-50 * Log Shop wage	.3480	.0497	.4257
Born 1951-56 * Log Shop wage	.6412	.0510	.7345

RMSE	.2293
$\frac{\sigma_\alpha^2}{\sigma_\alpha^2 + \sigma_\epsilon^2}$	.0750
R^2	.6224
Mean of Dependent Variable	2.9197
Number of Observations	11315
Number of Individuals	1628
Test of Fixed Versus Random Effects	14.384
P-Value	.1093

Table B-3

Estimated Tax Function
Dependent Variable: Total Income Taxes Paid/10000

Variable	Estimate	Stderr
intercept	-.1327	.0031
predicted tax/10000	.9335	.0022
(predicted tax/10000)^2	-.0173	.0001
RMSE	.3096	
R^2	.8648	
Mean of Dependent Variable	.9538	
Number of Observations	29760	