The Effect of Public Policies on Recent Swedish Fertility Behavior

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Abstract

In the literature the recent upsurge in period birth rates is seen as evidence of a pronatalist effect of Sweden's extensive social insurance programs. Yet, these explanations cannot account for the downturn in birth rates in the 1970s, the delay in childbearing, and the constancy of cohort birth rates which characterize recent Swedish fertility behavior. To summarize the effect of Sweden's economic and policy environment on the observed fertility patterns, I use a neoclassical economic framework to develop the shadow price of fertility. Although strong simplifying assumptions are imposed, the estimated price series exhibit a negative relationship with period fertility rates and the change in the estimated relative prices of fertility over the life cycle lend modest support for the delayed childbearing.

1.0 Introduction

During the last twenty-five years, period fertility rates in Sweden have exhibited considerable variation. Fertility rates fell sharply from the mid-1960s until the late 1970s, and since the early 1980s they have risen almost as quickly. In 1989, the total fertility rate was at the same level as in 1968, as Sweden has one of the highest birth rates in Western Europe. Superimposed on the time series variation in period rates is a shift in childbearing to later reproductive ages (Hoem 1990, Prioux 1990) and a near constancy of cohort fertility. The recent upsurge in period birth rates is loosely seen as evidence of a pronatalist effect of Sweden's extensive social insurance programs that are intended to facilitate market work by women with children (Hoem 1990). Yet, candidate explanations in the literature cannot account for the downturn in birth rates during the 1970s, the delay in childbearing, and the constancy of cohort birth rates. I use a simple neoclassical economic framework to illuminate the effect of Sweden's rapidly changing policy environment and economic conditions on these dimensions of fertility behavior. Based on the insight that most of the predictions of consumer behavior (Becker 1962) derive from the budget constraint, I use the economic framework to develop the shadow price of fertility. I estimate this price and use its time series pattern (and its various components) to explain observed fertility behavior.

Specifically, I look at two measures: (1) the shadow price of fertility for a 25-year old woman, and (2) the relative price of fertility at ages 35 and 24. Although strong simplifying assumptions are imposed, two suggestive results emerge. First, movements in the shadow price are broadly consistent with theoretical predictions: The shadow price of fertility increased substantially during the 1970s when period rates fell and decreased in the 1980s as fertility rates rose. Second, additional support for the effect of economic conditions on fertility behavior is that

the price of fertility at age 24 increased relative to the price at age 35, consistent with the delay in childbearing witnessed during the sample period. The change in the relative price is due primarily to the Solidarity wage policy which raised the wages of low-wage workers (particularly teenagers and young women) and reduced the return to human capital. During its implementation, a few cohorts of Swedish women faced rapidly rising wage levels. Compared to the earlier cohorts, more recent cohorts face wage profiles which are higher and flatter. Nearly flat age-earnings profiles remove the incentive to have children earlier in the life cycle. Thus a unique combination of economic conditions (wage solidarity) and public policy initiatives (expansion of the childcare system and parental benefit program), contributed to the observed pattern of period fertility rates in Sweden.

The outline of this paper is as follows. In the next section I summarize the pattern of Swedish fertility during the last thirty years. In Section 3, I exposit a simple neoclassical economic model to explain the potential influence of these institutional and environmental conditions on childbearing behavior in Sweden. In Section 4, I briefly describe recent economic conditions and the development of social programs which may be expected to directly affect the incentives to have children. Section 5 presents the estimates of the full price of fertility and reviews its time series behavior and connection to period fertility rates. I close with a summary.

2.0 Fertility Behavior in Sweden

Figure 1 reports the total fertility rate during the twentieth century. The long time series presented in Figure 1 permits a broad historical perspective, although the discussion below will center on the post-1955 period. Fertility rates plummeted in the first third of the century as Sweden experienced the demographic transition associated with the change from a predominately

agrarian to an industrial economy. Fertility rates during the Great Depression were low, even by modern "post-baby bust" standards. Fertility rates increased following the Second World War, but Sweden did not experience the baby-boom to the same degree as did the United States. The total fertility rate increased in the early 1960s and then declined until the late 1970s. Since the early 1980s, the total fertility rate has steadily increased to a level above replacement, matching its level of the late 1960s. Today, Sweden has one of the highest fertility rates in western and northern Europe, below only the traditionally high fertility countries of Ireland and Iceland.

The period-specific total fertility rate masks several interesting age-specific patterns. Figure 2 reports annual age-specific fertility rates for the period 1955-1989. A shift in childbearing to later ages is clearly evident. For younger age groups (teenagers and ages 20-24), fertility rates fell sharply with only a modest rebound recently for women in their mid-20s. The late twenties remain the primary childbearing years for Swedish women. Birth rates among women in this age group fell less dramatically than the two younger age brackets and the birth rates of the older age groups have been trending upward since the late 1970s. Since the mid-1980s, birth rates of women 30-34 surpassed those of women age 20-24. However, as is evident from Figure 2, this change is due as much to the rapid decline of birth rates among the younger age group as to an increase of births among the older age group. Birth rates among women 35-39 and 40-44 plateaued in the mid-1970s and increased slowly since. By 1989 they had reached their level of the mid-1960s. Except for a difference in level, the time series patterns of period-specific fertility rates for women in their mature (25-39) childbearing years are nearly identical. Generally, by 1989 period fertility was at the same level as it was in the late 1960s. Women giving birth were older on average in 1989 than those giving birth in the mid-1960s. For older age groups of women, birth rates have been increasing since the late 1970s. For young women, birth rates

increased slightly during the second half of the 1980s.

While Figures 1 and 2 consider period fertility rates, it is also interesting to consider measures of cohort fertility. Table 1 reports average number of children born by age for several single-year birth cohorts whose reproductive ages span the calendar period of Figure 1. The birth year of each cohort is reported at the top of each column. The average number of children by age are listed in the rows of the table. Completed fertility (total number of children born) or predicted completed fertility (described below) for cohorts who have not yet finished their reproductive ages is listed in the last row of the table. The numbers reported in Table 1, obtained by summing the appropriate age-specific birth rates over (calendar) time, approximate individual behavior over the reproductive life cycle. They are interpreted as the fertility age profile of a representative individual in the cohort who survives to the end of her reproductive career. For cohorts born after 1940, I estimate the completed fertility by using the 1989 age-specific rates to fill in their remaining reproductive history. For example, the estimated completed fertility for women born in 1950 is the sum of observed fertility to age 40 (1.976) and the predicted additional fertility during their forties, assuming their reproductive experience during these years is identical to women ages 40-44 and 45-49 in 1989.

The most notable feature of Table 1 is the stability in the completed fertility across cohorts. The period age-specific rates vary widely over time, yet the cohort measures of fertility are remarkably stable. The cohort experiencing the Great Depression during its late 20s (born in 1911) had the lowest level of completed fertility. The highest level of completed fertility is recorded by the cohort experiencing the postwar prosperity of the 1950s (born in 1936). Most surprising is the estimated completed fertility of the most recent cohorts. Their estimated

completed fertility is nearly identical to the completed fertility levels of the earlier cohorts.[1] This is particularly true for birth cohorts who are near the end of their reproductive period. For these cohorts (cohorts 1945, 1950) the fertility levels of the extrapolated ages have little influence on the completed level of fertility. Even the accumulated fertility at age 35 for the 1955 cohort compares favorably with previous cohorts (i.e., somewhat behind previous cohorts, but nearly identical to the 1931 cohort which had 1.95 level of completed fertility). The large variation in period fertility rates hides the stability of cohort fertility. For more than a half century, cohort fertility has varied within a narrow band of 1.9 to 2.1 children per woman.[2]

3.0 The Economic Model

As shown in the previous section, period fertility rates of all age groups have increased during the past few years. Rates among older women started to turn upward in the late 1970s while rates among younger women have increased only since 1985. Cohort fertility, however appears to be remarkably stable. What features of the contemporary Swedish economic and policy environment explain the variation in period fertility rates and encouraged the delay in

[1] Similar results obtain if the average age-specific rates from 1987-89 are used instead.

[2] Anticipating the subsequent discussion, it is useful to compare Sweden's fertility patterns with those of the United States. Since 1978, age-specific period rates increased modestly in the United States, about 9 percent compared to 22 percent during this period in Sweden. For both countries, most of this increase occurred among older age groups of women. However, the U.S. has not experienced the pronounced delayed childbearing as has Sweden. To illustrate, birth rates for women age 30-34, 35-39 and 40-44 increased 28.8, 52.0 and 25.7 percent compared to 60.9, 68.2 and 62.2 percent for comparable age groups in Sweden. While birth rates in Sweden at these age groups generally are at post-World War II highs, rates in the United States are below their 1968 (and earlier) levels. Finally, completed cohort fertility exhibits substantial variation in the United States. Using the same estimation procedure as reported in the text for Sweden, (estimated) completed fertility was 3.11 for the 1931 birth cohort, 2.24 for the 1950 cohort and 1.81 for the 1965 cohort.

childbearing? This section presents a simple economic model to address this question.

Following much of the previous work on life cycle behavior (e.g., Heckman (1976), Heckman and MaCurdy (1980), MaCurdy (1981), Moffitt (1984), and Cigno (1991)), I exposit a perfect foresight model. To focus on a few key dimensions, I make wide use of strong separability assumptions and fixed-coefficient technologies to eliminate many of the substitution possibilities.

Assume the terminal period occurs at age T, and the first decision is made at time period 1. The consumer obtains utility from a composite consumption good x_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 $U=\sum_{s=t}^{T} \beta^s[v(n_s)+u(x_s)]$,

where $\beta=1/(1+\rho)$, and $v(n_s)$ and $u(x_s)$ have the usual properties. Let the total time endowment equal one, and assume there are only two activities, working (h_t) and parental childcare ($f(n_t)$). Expenditures on children in year t is $g(n_t)$. Let ϕ^j denote the proportion of the year allocated to childbirth and childcare (assumed exogenous to the household). Then, $f(n_t)=\sum_{j=0}^{S_P} \phi^j b_{t-j}$, S_p is the maximum age of the child requiring parental time input into childcare. Assume that the childcare technology is of the fixed-coefficient variety and requires two inputs, time and market goods, scaled so that one unit of each input is required to produce one unit of output. Parental and nonparental time are perfect substitutes in childcare. Denote the expenditure on child-related

goods for a child of age s in year t as m_t^s, after-tax child allowances as α_t and the value of purchased childcare as c_t^s. Childcare expenses are incurred when the woman is working (h_t) and until the child attains age S_p, (so $c_t^s=0$, $s>S_p$). Direct expenditures start at birth and continue until the child is an adult at age M, ($m_t^s=0$, $s\geq M$). Total expenditures to support n_t children are given by:

$$g(n_t) = \sum_{j=0}^{M} (m_t^j - \alpha_t) b_{t-j} + h_t \sum_{j=0}^{S_p} c_t^j b_{t-j}$$

Normalize the individual's human capital endowment at one ($k_0=1$), and assume human capital accumulates according to the individual's labor market activity, $k_t=\exp(\mu_0+\mu_1\sum_{j=1}^{t-1} h_j)$. Wages equal the market rental rate on human capital times the individual's human capital, $w_t = \omega_t k_t$. Capital markets are perfect. Denote the constant rate of interest as r and the discount factor as $\delta_t=(1+r)^{-(t-1)}$.

Denote the parental benefit program as θ_t. Parental benefits and child allowances are financed by a proportional tax on earnings at rate τ_t. Assume 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

$$\begin{aligned} \max_{\{b_p x_t = 1,\ldots,T\}} \quad & \sum_{t=1}^{T} \beta^{t-1}\left[v(n_t) + u(x_t)\right] \\ & \textit{subject to} \\ & \sum_{t=1}^{T} (p_t x_t + g(n_t))\delta_t = A_0 + \sum_{t=1}^{T} (1-\tau_t) w_t h_t \delta_t \\ & w_t = \omega_t k_t = \omega_t \exp\left(\mu_0 + \mu_1 \sum_{j=0}^{t-1} h_t\right) \\ & n_t = \sum_{j=1}^{t} b_{t-j} \\ & 0 \leq b_t \leq \bar{B} \end{aligned} \qquad \textbf{(1)}$$

A woman selects the life cycle consumption and fertility levels (x_t,b_t; t=1,...,T) subject to the budget constraint, the law of motion for human capital and a biological restriction on the maximum fertility in a period. The first order conditions for the constrained optimization problem are:

$$\begin{aligned} \beta^{t-1}u'(x_t) - \lambda p_t \delta_t &= 0 \\ \sum_{j=t}^{T} \beta^{j-1} v'(n_j) - \lambda \pi_t &\leq 0 \qquad t=1,...,T \end{aligned} \tag{2}$$

where λ is the Lagrangian multiplier associated with the lifetime budget constraint and, by equation (2), equals the marginal utility of (after-tax) wealth. π_t is the full price of a single birth, and equals:

$$\pi_t = \sum_{j=0}^{T-t} ((1-\tau_{t+j}) w_{t+j} \phi^j - \theta_{t+j}) \delta_{t+j} + \sum_{j=0}^{T-t} (m_{t+j}^j - \alpha_{t+j} + (1-\phi^j) c_{t+j}^j) \delta_{t+j} + \mu_1 \sum_{j=1}^{T-t} (\sum_{l=0}^{j-1} \phi^l)(1-\tau_{t+j}) h_{t+j} w_{t+j} \delta_{t+j} \tag{3}$$

Notice the cumulative flows of utility accruing to fertility in period t (the second equation in (2)). This is the primary force to have children early in the life cycle. 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.

π_t is the full, present value cost of childbearing in period t. Although somewhat cumbersome, it is easily separated into its various components. The first term is the present value of the net (after-tax and after-program) opportunity cost of foregone earnings from childbearing. Much of the previous literature on child cost focusses on this component of cost (Joshi (1990), Espenshade (1984)). The second term is the present value of net expenditures on the child. Expenditures are disaggregated into purchases on goods (e.g., food, clothing) less

government subsidies ($m_t^j - \alpha_t$) and childcare expenditures, c_t^j. The institutional context in Sweden and the rise in women's employment motivate the disaggregation of expenditures. The last term is the net present value of foregone human capital accumulation due to child raising. If we let $V_t(n_t)$ denote the marginal utility flow,

$$\sum_{j=t}^{T} \beta^{j-1} v'(n_j),$$

then one informative way to summarize the first order conditions is

$$\frac{V_{t+1}}{V_t} = \frac{\pi_{t+1}}{\pi_t} . \qquad \textbf{(4)}$$

This relation characterizes how women will allocate fertility over their life cycle conditional on the life cycle 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 hand side of equation (4) is the price the woman is willing to pay to shift childbearing from period to t to t+1. The right hand side is the price available in the market to transfer fertility between periods.

Even with the strong assumptions on preferences and childcare technology, in periods when the household is not at an interior solution this model does not have the simple structure of many life cycle 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): $n_t = n_t(\lambda\pi_t, \lambda\pi_{t+1}, \ldots, \lambda\pi_T)$. However, there is still sufficient structure to gain insight into life

cycle decision making.

As the literature on life cycle labor supply has made clear, it is important to distinguish between two types of hypothesized changes to understand life cycle behavior (see MaCurdy 1985). The first, labelled evolutionary, measures the consumer's response to an anticipated change in the life cycle profile of prices or resources. Fully anticipated, these life cycle changes have no effect on the marginal utility of wealth (λ) and can be analyzed using the conditional demand functions $n_t = n_t(\lambda\pi_t, \lambda\pi_{t+1}, ..., \lambda\pi_T)$ which measure intertemporal responses to anticipated changes in life cycle profiles. For example, consider rotating the sequence of prices $\{\pi_t, t=1,2,..,T\}$ such that the profile is steeper but lifetime wealth remains constant. Then, equation (4) implies the consumer will shift childbearing to earlier in the life cycle when it is relatively cheaper. Thus, holding wealth constant, an anticipated steeper profile of the price of fertility implies a faster tempo of fertility.

The second type of change is the usual comparative statics exercise which changes either the profile or the level of prices or resources and generally does not keep wealth constant. Comparisons across individuals facing different initial endowments and time series profiles of prices and incomes fall within this class of thought experiments. Unfortunately, as frequently happens in life cycle labor supply models, because wealth and substitution effects work in conflicting directions, few predictions are available. For example, consider two otherwise identical individuals with the first facing a flatter and lower sequence of fertility prices over the life cycle. If wealth were constant, the second woman, who faces a steeper profile of the price of fertility, should choose to have children relatively early in the life cycle. However, assuming child services are a normal good, reduced lifetime wealth will reduce the demand for births. The second individual should have fewer children but have them earlier in the life cycle. Thus, for

latter reproductive ages, the individual facing the steeper and higher sequence of fertility prices should have lower birth rates. Whether fertility rates early in the life cycle are greater or less than those of the first individual depends on the relative magnitudes of the substitution and wealth effects. The stability of cohort fertility presented in Table 1 suggests that the wealth effect on completed fertility is zero. For the remainder of the discussion, I will assume that the wealth effect on completed fertility is zero, so that all the wealth effects are translated only into changes in timing but not total number of births.

The effects of changes in the economic and policy variables are understood by examining their effect on the profile of the shadow price of fertility. Changes which make the profile steeper increase the tempo of fertility (absent effects on completed fertility). Conversely, changes which tend to flatten the profile will tend to delay fertility. The magnitude of the intertemporal response depends upon the magnitude and timing of profile changes. The adjustment to an anticipated increase in prices near the end of life can be spread over many earlier periods. An increase in wealth will tend, by the cumulative nature of the utility flows, to increase the tempo of fertility. For example, during a period of rising wages (*ceteris paribus*) women have an incentive to have children early in the life cycle when the opportunity cost of their time is less. Higher future wages also increase lifetime wealth which provides a further incentive to increase the tempo of fertility. Increases in either direct child expenditures or childcare costs increase the shadow price of fertility, with the largest effect (because of discounting) accruing to changes for children of younger ages. Of course, increases in child allowances, α_t, reduce the cost of fertility. Changes in the tax rate are, with a change in algebraic sign, the same as a change in wages. From the preceding paragraph, an increase in the tax rate reduces the after-tax wage and provides an incentive to delay fertility.

The effect of the parental benefit scheme is easiest to see if we assume that labor force withdrawal for childbearing is confined to the first year following childbirth. Anticipating the discussion of programs in the next section, denote the parental benefit as $\theta_t = \eta_t w_t$, where η_t is the after-tax earnings replacement rate. The opportunity cost of foregone earnings equals = $(1-\eta_t)(1-\tau_t)w_t$. Written in this form it is clear that parental benefits attenuate the effect of wage increases. Increases in parental benefits offset the opportunity cost of foregone earnings and reduce the price of fertility. In the absence of human capital accumulation, if individuals are fully covered ($\eta_t = 1$), female wages have only a wealth effect and no substitution effect on fertility.[3]

Now consider an increase in the rate of return to human capital (ω). For a given exogenous wage component profile, the individual's wage profile has become steeper. By increasing the tempo, early birth reduces the cost of foregone income and the loss associated with human capital accumulation. With early fertility more of this loss will occur at the lower stock of human capital (absent any wealth effects leading to different desired completed fertility).

4.0 Economic and Policy Environment, 1960-1990

This section provides a brief summary of the economic and policy environment during the period 1960-90 (for additional discussion see Olson (1987), and Aronsson, Heckman, and Walker (1993)). The discussion will be selective, attempting to highlight the important

[3] If capital markets are imperfect, then parental benefits and spousal earnings have an additional role to play. When couples can not 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.

institutional and policy changes during the last thirty years.

4.1 General Overview

Following the Second World War and well into the 1970s, Sweden experienced healthy economic growth. From 1948 to 1975, Gross Domestic Product grew at an average annual rate of slightly over 3 percent. This compares favorably with the 2.3 percent growth rate of the United States. Following this period, economic growth has been modest and, for some periods, entirely absent. The first oil shock hit the Swedish economy hard (external sources provide 75 percent of its energy), and the economy stagnated during the late 1970s. The economy was still weak during the early 1980s. Since the mid-80s, GDP has grown at a rate of 2 percent per annum, below the high growth years of the middle of the century but far better than the previous decade.

Real wage levels reflect the general trend in economic growth. For men, real wages grew at an average annual rate of 3.5 percent until 1977, declined during the late 1970s, and began to exhibit modest growth after 1985. Female wage rates grew both in absolute terms and relative to male wages. From 1948 to 1980 real female wages grew at an annual rate of 4.3 percent, from approximately 70 percent to slightly over 90 percent of male wages. Since 1980, female wages have remained at 90 percent of male wages. As discussed in Flanagan (1987), Heckman and Walker (1990), Hibbs (1990), and Edin and Holmlund (forthcoming) the rapid growth in female wages was due to the implementation of the "solidarity" wage policy. Initiated in the early 1960s, the policy sought to equalize wages without regard to industry profitability or individual productivity. The effect of the policy was to increase the wages of low wage workers, predominately teenagers and women. As Hibbs (1990) documents, the policy effectively compressed the wage distribution. By increasing the wages of young workers, the policy shifted

the age profile of wages (Figure 3). Women born in the more recent cohorts start at higher initial wages, but experience less growth in wages over the life cycle. For example, at age 20 wages of women born in 1940 are 38 percent higher than wages of comparable women born in 1930. Moreover, by age 25, wages of women in the younger cohort are at the same level as wages of the older cohort with little life cycle growth in wages for either cohort.[4] In work reported elsewhere (Walker 1994), and consistent with the flattening of the age profile of wages, I estimate that during the 1970s, the return to experience declined from 2.7 percent to 1.3 percent.[5]

4.2 Social Insurance--Programs Directed at Families and Children

Sweden maintains an extensive system of social insurance programs to buffer its residents from a harsh environment. The 1970s were a major policy epoch for the reform and extension of social program benefits and services. While relatively few new programs were initiated, many existing benefits and services were extended. The most notable of the program extensions was the transformation of maternity allowances into parental benefits in 1974. Prior to 1974, at the event of childbirth women were entitled to maternity allowances. Benefits were not taxed, and since 1955, they have been part of the sickness insurance system. All women were eligible to receive a guaranteed amount, and working women were entitled to supplemental benefits designed to replace approximately 80 percent of the worker's after-tax earnings for a maximum of 180-day period of continuous non-employment. Eligibility for the supplemental benefits required that the

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[4] These wages profiles are from the age-specific wage profiles for female shop assistants and salesperson constructed by Tasiran and Gustafsson (1990). The age profiles for all cohorts flatten in the mid-70s.

[5] These estimates are from log wage specifications using earnings data from individual tax returns for the respondents of the 1981 Swedish Fertility Survey combined with hours of work information recorded in the Fertility Survey. A random effect estimator is used and specifications include controls for age, education, experience, and the log of the shop-assistant's wage (which is gender and age-specific).

woman be insured for sickness benefits 270 days before the date of birth and have earnings above a minimum level (roughly 20 percent of the earnings of the average industrial full-time worker).

In 1974, the maternity allowance program was converted to a parental benefit system to bring the program fully within the National Health Care system and to recognize the father's parental responsibility. Now, either parent could receive payment to stay home and care for the newborn child (although, of course, not both simultaneously).[6] Parental benefits are taxable and contribute to the individual's public pension. Nonworking women receive a guaranteed minimum daily benefit amount (25 kr in 1974). Working individuals are entitled to receive their sickness insurance rate equal to the maximum of the guaranteed minimum or 90 percent of their average daily earnings. Supplemental parental benefits were introduced in 1977. Parents could share 180 days within the first 270 days of the childbirth with benefit payments at the sickness benefit rate, and another 90 days at the guaranteed minimum, to be used anytime before the child is eight years of age. Supplemental benefits were extended again in 1978 and 1980. (Basic) parental benefits and supplemental benefits were consolidated into one program in 1984. Parents receive their sickness insurance rate for the first 270 days and the guaranteed rate (60 kronor in 1984) for another 90 days. Benefits are payable until the child is four years old. Benefits were extended again in 1988. Parents now share 450 days of parental benefits, 360 at the sickness insurance rate and 90 days at the guaranteed benefit of 60 kronor. The length of the benefit period was reset to the child's eighth birthday. A change in the administration of these benefits occurred during the late 1970s (Hoem 1990). Since 1980, the law has formally recognized

[6] Until 1983, a father was entitled to receive 90 percent of his labor market earnings only if the woman was entitled to receive sickness benefits above the guaranteed minimum.

entitlement to earnings-related parental benefits for subsequent births within twenty-four months (extended to 30 months in 1986) of the preceding birth. That is, women need not enter the labor market between births to become re-entitled to earnings-related parental benefits. According to Gustafsson and Jacobson (1985), under the parental benefit program a woman must work six consecutive months or 12 of 24 months preceding the birth-related labor withdrawal. As Hoem argues, the change in the administration of benefits should increase the tempo of fertility.[7]

Additional programs directed at families with children deserve mention. Since 1979, parents have had the right to return to their previous employment within eighteen months of childcare. In 1974, temporary childcare benefits for the care of sick children or when the child's caregiver is ill were introduced. Originally set at 10 days per year, per child under the age of 12, these benefits were expanded in 1977 to 12 days per annum for families with one child (15 days for families with two children and 18 days for families with three or more children), and again in 1980 to 60 days per child under age 10. Finally, and historically the oldest program, in lieu of income tax deductions, households with children receive child allowances. These untaxed cash payments are paid quarterly until the child is age 16. Allowances increase linearly with the number of children, and since 1983, households with three or more children are entitled to an additional one-half allowance. Table 2 lists the level of child allowances since 1948.

In the mid-1970s, Sweden embarked on an ambitious program to expand publicly provided day care. A 1975 law required local governments to provide low cost center-based childcare by 1980 to all six-year olds residing in their boundaries. Although most local governments did not reach this goal, publicly provided childcare has expanded substantially since

[7] Hoem's analysis, however, does not support his conclusion that the administrative change increased fertility during the 1980s. See Walker (1992) for a discussion.

the mid-1970s. Gustafsson and Stafford (1992) report that the ratio of spaces to children increased from 0.15 in 1975 to 0.47 in 1987.[8] Even with the massive construction program, demand for public day care slots far surpassed the available supply. The mismatch between supply and demand was greatest in the rural areas of the north and was least in the urban areas (e.g., Stockholm, Malmö, Göteborg) in the south. To meet this demand, the government presented legislation in 1985 aimed at providing municipal childcare services by 1991 for all preschool children age 18 months to 6 years. The high quality of Swedish facilities and the large government subsidies contribute to the excess demand for public slots.

4.3 Taxes

Since 1960, Sweden has experienced several major tax reforms. In 1966, high income couples were given the option of filing separate or joint income tax returns on their labor earnings. In 1971, the individual was made the basic tax unit, and all individuals are separately taxed on their earned income. Until 1985, couples were jointly taxed on their capital income. From 1960 to the mid-80s income tax rates (marginal and average) increased substantially. Indeed, by the early 1980s special legislation stipulated a maximum marginal tax rate of 85 percent. Separate taxation offset the increase in taxes for working women and through a series of tax reforms, income tax rates have fallen since the mid-1980s. Major tax reforms in 1986 and 1991 simplified the number of brackets and reduced the progressivity of the national tax schedule. Figure 4 plots the average tax rate for a married woman working full-time with at least one child. Prior to 1971, the rates plotted in Figure 4 assume the woman is taxed at the marginal rate

[8] These estimates include family day homes--individuals who care for three to four children in their private homes. These individuals are selected, trained and monitored by the local government. They provide a substantial portion of the care, particularly to infants and young children. Fees for publicly provided family day homes and center care are about the same--parents pay about ten percent of the full cost.

associated with her husband's earnings. Households with children faced slightly lower tax rates than households without children. These differences were eliminated in 1971.

5.0 Illustrative Numerical Estimates of π_t

This section combines the theoretical model of Section 3 and the institutional details of Section 4 to interpret the time series patterns of the period fertility rates presented in Section 2. The components of the shadow price of fertility change over time in ways which make it impossible to make qualitative predictions about fertility behavior. Prediction requires that quantitative magnitudes be associated with each of the components to assess changes in the cost of children over time. Clearly a Herculean task, yet several such estimates appear in the literature (e.g., Calhoun and Espenshade (1988), and Espenshade (1977, 1984)), although none are tailored to the Swedish context. The primary conceptual difficulty is that π_t is **endogenous**.[9] Several components of the π_t clearly depend on household decisions. For example, the length of labor force withdrawals for childbearing affects both the opportunity cost of foregone earnings as well as the opportunity cost of foregone human capital accumulation. The increasing generosity of the guaranteed parental benefit and the lengthening of the duration of benefits since the mid-1970s should lengthen the time away from the market following childbearing (ϕ^j). Moreover, the use of market versus parental time-inputs into childcare as well as the choice of time versus goods input into children are decisions of the household and should respond to changes in relative prices. For expositional convenience the theoretical framework did not include "child quality" in its formulation. Yet, the fraction of household income spent on children will depend on consumer preferences and will vary across households and also cohorts,

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[9] The same issue appears in models of household production when the household production function is not characterized by constant returns to scale fixed-coefficient technology. See Deaton and Muellbauer (1980) pp. 247-249 for a fine exposition.

depending on substitution opportunities facing households. All of these dimensions make π_t endogenous. The proper way to interpret π_t is as a shadow price evaluated at the optimum values. Thus, any purported measurement must not only define expected prices, but also must condition on expected optimizing behavior. In the following discussion, I consider only direct effects on fertility behavior (i.e., changes operating through π_t) and do not consider indirect effects (i.e., changes in behavior changing the structure of π_t).

5.1 Specification of the Baseline Parameterization

I construct the time series of the shadow price of fertility assuming a static expectation process--prices, childcare availability, benefits, and taxes for all future periods are forecast at their current levels. This is the rational expectations forecast if the variables follow a first order Markov process.[10] Wage forecasts are also myopic and use the current age-earnings profile as individuals are assumed to look to the earnings of current older workers to forecast their own future (age-adjusted) earnings.

Table 3 summarizes the parameterization of the baseline assumption set used to calculate π_t. Three key behavioral assumptions underlie the calculations. First, I assume that women leave the labor market for childbirth and remain out of the market for the entire first year. After the first year, they work part-time until the child is school age (a common profile in the Swedish Fertility Survey); that is, $\phi^1 = 1$, $\phi^j = 0.5$, $2 \leq j \leq 6$. Second, to calculate the foregone human capital accumulation I assume, except for the time spent caring for the current birth, that women expect to work full-time in all future periods ($h_l = 1$ for l not equal to t). This is equivalent to an assumption of no future births, as future fertility will reduce future labor market participation.

[10] If the true process is $z_t = a+bz_{t-1} + \varepsilon_t$ and ε_t is independently and identically distributed, then the optimal forecast (by a mean squared error criterion) is $z_t^e = a + bz_{t-1}$. Note, however, that static expectations violate the perfect foresight assumption of the theoretical model.

Third, I assume that direct child expenditures are constant at 3853 kronor (in 1969 kronor, or 6665 in 1976 kronor). As described in Appendix A, I obtain this estimate by comparing expenditures of families with children versus those without children. I follow the literature and consider expenditures through age sixteen to avoid having to estimate expenditures on post-high school education. However, large public subsidies for higher education make this less important in Sweden than in the United States. I also do not need to estimate medical costs of childbirth, because Sweden's National Health Care system fully covers the direct medical cost.

Comprising three separate elements, childcare expenditures are particularly difficult to estimate. (Expected) childcare cost is a weighted average of public and private childcare costs. The weight factor is the availability of publicly-provided childcare slots, defined as the ratio of preschool-aged children to public slots as reported in Gustafsson and Stafford (1992). Following their statement that a ratio of 0.65 represents a no-rationing level of public slots, I rescale the ratio so that 0.65 corresponds to 1. I interpret the series as the probability of obtaining a slot in public childcare. Stafford and Gustafsson also provide information on the real cost of public childcare slots for the period 1975-1987. Assuming constant real prices for public childcare, an assumption supported by their data, I use the 1975 price to estimate the price in earlier years, and the 1987 price to estimate the price in 1988 and 1989. Similarly, I use the coverage ratio of 1987 to estimate the availability of childcare slots in 1988 and 1989. To estimate the availability of childcare slots for years before 1975, I use retrospective data on childcare usage reported in the 1981 Swedish Fertility Survey. For the years they have in common, (1975-1980), the two data sources yield measures of childcare usage that agree both in level and in trend.

Although much has been written about Sweden's public childcare system, little has been written about its private system. Gustafsson and Stafford (1992, p.222) state that households

rationed out of the public sector face much higher cost alternatives in the private sector. They comment that the gap between public and private day care may be as much as 30,000 kronor (in 1988 kronor, p. 214). This is approximately five times the cost of a public slot. Since this estimate is presumably an upper bound, I estimate private childcare costs as four times the cost of public care.[11]

The other components of π_t are reasonably straightforward. Conceptually, the discount factor should be based on the real interest rate in period t. Real interest rates (calculated as the T-bill rate less inflation, as measured by the Consumer Price Index) were negative for the decade of the 1970s. Real interest rates facing consumers (who cannot borrow at the T-Bill rate) may not have been strictly negative. For the baseline model, I assume consumers face a constant real interest rate of 3 percent.[12] Program benefits (parental benefits and child allowances) are from documents published by Statistics Sweden. Annual average tax rates are calculated from national tax schedules and an annual estimate of the local tax rate reported in Tasiran and Gustafsson (1990). Female earnings are the age-specific annual earnings for shop-assistants reported in Tasiran and Gustafsson (1990).[13] Male earnings equal 2000 hours times the average manufacturing male wage rate. I use results in Walker (1994) and Hibbs (1990) to set the rate

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[11] The growth in the availability of public slots is the primary factor driving the cost of childcare time series, not the difference in the estimated cost of private child care. See Appendix B for additional discussion.

[12] As pointed out by a referee, one would expect that in the presence of uncertainty, individuals discount the future more. However, the results are robust to reasonable changes in the discount rate. See Appendix B for additional discussion.

[13] The compression of the wage distribution resulting from the solidarity wage policy makes any occupation-specific wage series an increasingly representative measure of wages in the economy. For example, the time series correlation between manufacturing wages and the shop assistant wage is large; the lowest correlation among all the age groups is 0.97. Indeed, as Figure 17 in Appendix B shows, the time series profile of the shadow price of fertility is robust to the wage measure used.

of return to human capital, μ_1: 4.1 percent before 1966, 2.7 percent 1966-1975, and 1.3 percent 1976-1989.

The theoretical framework suggests two time series of prices are important for understanding recent fertility behavior in Sweden. To capture the time series variation in period rates, I present a time series of the shadow price of fertility for a twenty-five year old woman. The late twenties are the prime childbearing years and a price of fertility calculated for this age group will give insight into the time series variation in the level of fertility. However, the shift of childbearing to later ages witnessed during this period implies that the price of fertility at younger ages has increased relative to that at older ages. Therefore, I also present a time series of the price of fertility at age 35 relative to that at age 24.

5.2 Time Series Profile of the Shadow Price of Fertility

Figure 5 plots the four basic components (direct expenditures, childcare, foregone earnings and foregone human capital accumulation) of the shadow price of fertility for the baseline assumption set summarized in Table 3.[14] The price series exhibits no secular trend. During the period 1955-1989 the correlation between the total fertility rate and a one-year lag (to account for gestation) of the shadow price is a modest -0.084. However, the correlation between the total fertility rate and the work-related components (childcare, foregone earnings and foregone human capital) lagged one period is a larger -0.467, and the correlation between the total fertility rate and earnings-related components (foregone earnings and human capital) is larger still, -0.626. Moreover, the effects of several public policies and economic conditions are visible in the price series. Although *gross* direct expenditures are held constant, the *net* direct expenditures decline

[14] The C programs used to develop all of the estimates reported in the paper are available (via a diskette or email) at no charge upon request.

because of the increasing generosity of child allowances. The secular increase in female wages and the 1971 reduction in the marginal tax rates facing women are clearly visible in Figure 5. Also evident is the increasing generosity of the parental benefit program which reduced the lost earnings component (major extensions in 1975 and 1988). Gradual increases in the income tax rate, lower return to human capital, and less generous program extensions account for declines in the full price of fertility in subsequent years.

The component shares exhibit systematic variation over time. Initially, direct expenditures is the largest component comprising 45 percent of the total cost, net foregone earnings equal 32 percent, and childcare and human capital components account for 15 and 8 percent respectively. However, in 1971 net foregone wages becomes the primary component of cost with a 42 percent share compared to 38 percent for direct expenditures. During the late 1970s and beyond, foregone earnings continue to increase and by the late 1980s represent one-half of the total cost. Meanwhile, direct expenditures remain constant at 38 percent and childcare components and human capital care components decline to 8 and 4 percent, respectively.

I perform a sensitivity analysis to assess the relative importance of the assumptions used to generate the shadow price and to investigate its robustness. The first robustness check modifies household preferences to include child "quality" as well as the number of children into the flow of child services. Properly defined, a price index should hold constant the attributes of the good. Yet, "child quality" -- increased investment in children -- is a common explanation for the secular decline in fertility observed in industrialized countries. One suspects that as a household becomes more wealthy, it is unwilling to devote a smaller share of its resources (constant magnitude) to direct child goods. Assuming a unitary expenditure elasticity is a simple way of incorporating child "quality." Therefore, instead of being constant in real terms, assume

that gross direct child expenditures are a constant fraction (20 percent) of household income.[15] By this measure, the shadow price series increased rapidly during the 1960s and peaked in the mid-1970s. It declined until the mid-1980s, when it began to increase again. The direct expenditure component dominates the other price components, accounting for 50 to 70 percent of the total cost. It is not surprising that a strong negative correlation occurs (-0.777) between the total fertility rate and a one period lag of this full-price index.[16]

The time absent from the labor market following a birth is the single most important assumption used in the construction of the full-price of fertility. With the exception of direct expenditures, all of the other components depend on this assumption. Figures 7-10 exhibit the robustness of the full-price of fertility and its components to changes in the length of the assumed absence from the labor market. In these figures a "short" absence corresponds to one year immediately following the birth, part-time employment in the second year, and resumption of full-time work thereafter. The "long" absence equals total withdrawal from the labor market for the first 6 years, and part-time employment before the child becomes school age the next year. Figure 7 reports the time series profile for the shadow price series, and Figures 8, 9 and 10 report

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[15] Two different sets of estimates lead me to estimate expenditures as 20 percent of pretax household income. Using the 1972-73 (United States) Consumer Expenditure Survey, Lazear and Michael (1988, p. 147) estimate that households spend one dollar on children for every two and one-half dollars spent on adults. Extending this spending pattern to Sweden and assuming an average tax rate of 33 percent implies that 19 percent of before-tax income is spent on children. Alternatively, again for the United States, Espenshade (1977) reports that middle income families spend 33 percent of their after-tax income on children. Removing expenditures for health and education (approximately 10 percent), and applying the same 33 percent tax rate, I estimate child expenditures to be 20 percent of pre-tax family income. Also, using the expenditure patterns reported in Espenshade (1977), adjusting child expenditures by the age of the child had no effect on either the level or the time series pattern of π_t.

[16] A similar, if somewhat less dramatic, pattern emerges if direct expenditures are assumed to be 10 percent of household income.

on work-related components (direct expenditures are assumed constant as indicated in Table 3). Notice from Figures 8 through 10, the times series profile of components is broadly similar with respect to the assumed labor market absence. Not surprising, short absences incur smaller costs. Figure 7, however, reveals a richer interpretation. For long labor market absences, lower marginal income tax rates and higher female wages substantially increased the shadow price of fertility since the early to mid-1970s. The increased generosity of public programs (child allowances, parental benefits and publicly provided childcare, along with gradually increasing marginal income tax rates) arrested further increases in the price of fertility. For short absences, the social insurance programs more than offset the effects of lower marginal income tax rates and increasing female wage rates and led to a decline in the price of fertility. Indeed, with a brief increase in the early 1970s, the price of fertility assuming short labor market absences declines nearly uniformly since the mid-1960s. This series has a positive correlation with the total fertility rate, (0.538), implying that fertility rates should not have exhibited their decline during the 1970s. More importantly, Figure 7 illustrates that nearly *any* time series pattern of shadow fertility prices can be obtained by the judicious choice of labor market absence. Of course, labor market absence is not exogenous, and the value of these calculations is to highlight the relative contribution of the various components, not to discover necessarily the "true" price of fertility.

By holding constant parameters of the shadow price of fertility, additional information is obtained on the relative magnitudes of its components. These results are presented in Figures 11 and 12. In these figures parameters are fixed at the real value of their 1965 level. All series are denominated in 1976 kronor, and Figures 11 and 12 have the same scaling to facilitate comparisons. Figure 11 plots the baseline shadow price and three counterfactual shadow price series: one fixes the distribution of female wages, another fixes the income tax rate, and the third

holds constant the return to human capital. Figure 12 presents alternative fertility price time series holding constant the public programs directed at families and children. The distance between the baseline price series and an alternative price series measures the quantitative importance of the parameter on the shadow price of fertility.

Figure 11 makes clear the obvious yet often neglected observation that the single most important determinant of the shadow price of fertility is the female's wage rate. Had women's wages *not* experienced substantial growth during this time period, by the late 1980s, the shadow price of fertility would have been 20 percent lower. This is about twice the magnitude of any other change considered. The second largest factor is the decline in the return to human capital. In addition to its effect on intertemporal decisions (discussed below), by the late 1980s the declining return to human capital reduced the shadow price of fertility by about 9 percent. Whereas changes in the wage distribution and reductions in the return to human capital had persistent effects on the shadow price of fertility, changes in the income tax had more temporary effects. The change to individual taxation in 1971 had a large effect on the shadow price of fertility, but subsequent increases in the tax rate (especially the local tax rate) offset the initial reductions. By the late 1980s the effect of tax changes is less than 1 percent. However, the large effects for wages and the return to human capital suggest that economic conditions had a larger influence on fertility decisions than did the highly regarded public policies directed at families and children.

Increases in child allowances modestly reduced the shadow price of fertility, with most of the reduction occurring after 1983. The increased generosity of the parental benefit program and the increased availability of public childcare had more persistent effects. These effects were approximately twice the effect of the increased child allowances. The potential pronatalist effects

of the parental benefit program have been widely recognized in the literature. These results imply that the expansion of the public childcare program was equally influential. Moreover, a comparison of the wage and human capital effects in Figure 11 with the effect of public policies in Figure 12 highlights the relative importance of economic conditions on the shadow price of fertility and consequently on fertility decisions. The potential influence of the economic conditions variables is masked because, to a large extent, the effects offset one another (i.e., increases in the female wage increase the shadow price of fertility, whereas reductions in the return to human capital lower the shadow price).

5.3 Life Cycle Changes in the Shadow Price of Fertility

Is there any evidence that the public policies or the economic environment contributed to the delay in childbearing? Figure 13 plots the shadow price of fertility and its earnings-related component (foregone earnings and foregone human capital accumulation) for women at age 35 relative to those at age 24. A ratio below 1.0 implies that economic conditions favor fertility at age 35 over age fertility at 24. The relative price of fertility varies with the woman's age for two reasons: (1) foregone earnings will differ because of the age profile of wages; and (2) foregone human capital accumulation will accrue for fewer years on a larger base for births occurring at later ages. Secular changes in the distribution of wages and the return to human capital generate time series changes in the price series. While both relative price series exhibit little variation over time, the increasing relative price at younger ages is consistent with the delayed childbearing presented in Figure 2. Wage-related costs, however, comprise a sufficiently small portion of the total cost so that change in the age-earnings profile induce little change in the relative shadow price of fertility. The price of childbearing at age 24 increases primarily because of the flattening of the age-earnings profile due to the implementation of the solidaristic wage policy. The

opportunity cost of foregone earnings is, therefore, relatively greater for members of the younger cohorts. Women in the most recent birth cohorts have an earnings profile which is higher and flatter than that facing women in the early cohorts. These changes increase the absolute price of fertility but imply there is less of a relative cost to delayed childbearing.

Other factors not incorporated into the price of fertility shown in Figure 13 may provide additional incentives to postpone childbearing. First, women may have learned that it is easier to balance the demands of family and career if they start their family at later ages. Although a form of human capital, perhaps one that is productive in both the market and nonmarket sector, this form of knowledge or ability need not affect market wages. The solidarity wage policy implies that the return to this form of human capital may be in non-monetary factors, e.g., a more interesting job, more responsibility, or a preferred work schedule. Second, if human capital depreciates during absences from the market and if the depreciation rate is negatively related to the amount of human capital (experience) or the individual's age, then women will have another incentive to work and become established before leaving to start a family. Moreover, the primary thrust of Sweden's social policy was to increase equality between the sexes and specifically to give women equal opportunity in the labor market. The increased opportunity for women to combine family and work increased women's access to the market and their commitment to the market sector. With their expanded opportunity set it is not surprising that women substituted away from traditional home-oriented roles, reduced their fertility and entered the labor market. Finally, the price indices assume myopic expectations. Yet, women may postpone childbearing if they expect the future environment to be more conducive to balancing family and career demands. The increased generosity of the parental benefit program, the rapid expansion of programs (e.g., temporary childcare benefits and employment security laws), and the public

pronouncement of an expanded childcare system should have caused many to expect that the future will be increasingly conducive to childbearing while working. These expectations are not reflected in the myopic price index.

5.4 Summary

The results in Figures 5 and 11-13 reconcile my recent findings (Walker 1991) with my earlier work with Heckman (Heckman and Walker 1990). In the earlier work, we find large and statistically significant negative effects of the female wage on the timing and spacing of births. However, we also find evidence of a pronatalist shift in the estimated female wage effect across cohorts of Swedish fertility. In Walker (1991) microdata on earnings and taxes are used to estimate a joint fertility-employment process, and the estimated negative effect of female wages on fertility remains. However, the estimated effect of parental benefits is also negative (and statistically significant). Identification of the effect of parental benefits rests on time series changes in the benefit rate and the duration of benefits. Its strong connection to the female wage, combined with the large movement in income tax rates and other factors connected to wages, makes it impossible to estimate the separate effects of parental benefits. The time series pattern of the price series reported in Figures 5 and 6 and the change in relative prices in Figure 13 suggests that the early interpretation is correct: the changing age profile of wages and more generous parental benefits make the current female wage an increasingly less accurate measure of the price of fertility. The expanding childcare delivery system further reduces the price of fertility.

6.0 Conclusion

The substantial variation in period fertility rates in Sweden calls into question the role of economic conditions and public policies on life cycle fertility behavior. The long-run stability of cohort fertility, however, implies that the effect of economic variables is on the timing and spacing of children, and apparently has little influence on completed fertility. The economic framework presented develops a simple measure of the price of fertility to assess the time series changes. The assumptions used to develop this price and the rough empirical estimates require a cautious and modest interpretation of causal mechanisms. Yet, the estimated price of fertility increased dramatically during the 1970s as total fertility rates plummeted. The decline in the total price of fertility during the 1980s is roughly consistent with the recent increase in period fertility rates. Moreover, the time series pattern of the relative price of fertility is also consistent with the shift in childbearing to later ages. While the increase in the relative price of early fertility is small, it is larger when attention centers on earnings-related components of the price of fertility. The solidarity wage policy had the effect of increasing the level of wages while flattening age profile of wages. Consequently, women of more recent cohorts have less incentive to have their children early in their reproductive life cycle.

The programs in Sweden are pervasive and intertwined within a complex social insurance network. Parsing the effect of a single program is nearly impossible. The analysis is therefore only suggestive, but it provides evidence that additional analysis of the role of public policies and economic conditions will be empirically fruitful.

References

Aronsson, T., J. Heckman, and J. Walker (1993). "The Effects of the Swedish Welfare State on Labor Supply Incentives," unpublished manuscript, University of Wisconsin-Madison.

Agell, A. (1979). "Sweden." In A. Samuels (ed.), **Social Security and Family Law**, Vol. 4. United Kingdom Comparative Law Series.

Becker, G. (1962). "Irrational Behavior and Economic Theory," **Journal of Political Economy** 70:1-13.

Bjorklund, A. (1986). "Assessing the Decline in Wage Dispersion in Sweden," unpublished paper, IUI, Stockholm.

Calhoun, C. and T. Espenshade (1988). "Childbearing and Wives' Foregone Earnings," **Population Studies** 42(1):5-37.

Cigno, A. (1991). **Economics of the Family**. Oxford: Clarendon Press.

Deaton, A. and J. Muellbauer (1980). **Economics and Consumer Behavior**. New York: Cambridge University Press.

Edin, P-A. and B. Holmlund (forthcoming). "The Swedish Wage Structure: The Rise and Fall of Solidarity Wage?" In R. Freeman and L. Katz (eds.), **Differences and Change in Wage Structures**. University of Chicago Press.

Espenshade, T. (1977). "The Value and Cost of Children," **Population Bulletin** Vol. 32 (April).

Espenshade, T. (1984). **Investing in Children: New Estimates of Parental Expenditures**. The Urban Institute Press, Washington, D.C.

Flanagan, R. (1987). "Efficiency and Equality in Swedish Labor Markets." In B. Bosworth and A.M. Rivlin (eds.), **The Swedish Economy**. Washington D.C.: The Brookings Institution.

Gustafsson, S. and F. Stafford. (1992). "Childcare Subsidies and Labor Supply in Sweden," **Journal of Human Resources** 27:204-230.

Heckman, J. (1976). "A Life Cycle Model of Earnings, Learning and Consumption," **Journal of Political Economy** 84:S11-S44.

Heckman, J. and T. MaCurdy. (1980). "A Life Cycle Model of Female Labor Supply," **Review of Economic Studies** 46:47-74.

Heckman, J. and J. Walker. (1990). "The Relationship Between Wages and Income and the Timing and Spacing of Births: Evidence from Swedish Longitudinal Data," **Econometrica** 58:1411-1441.

Hibbs, D. (1990). "Wage Compression Under Solidarity Bargaining in Sweden." Economic Report No. 30, Stockholm: Trade Union Institute for Economic Research.

Hoem, J. (1990). "Social Policy and Fertility Change in Sweden," **Population and Development Review** 16:735-748.

Hotz, V.J. and R. Kilburn (1991). "Childcare Usage," NORC Working Paper, University of Chicago.

Joshi, H. (1990). "The Cash Opportunity-Cost of Childbearing: An Approach to Estimating Using British Data," **Population Studies** 44:41-60.

Lazear, E. and R. Michael (1988). **Allocation of Income Within the Household**. Chicago: University of Chicago Press.

MaCurdy, T. E. (1981). "An Empirical Model of Labor Supply in a Life Cycle Setting," **Journal of Political Economy** 89:1059-85.

MaCurdy, T. E. (1985). "Interpreting Empirical Models of Labor Supply." In B. Singer and J. Heckman (eds.), **Longitudinal Analysis of Labor Market Data**. Cambridge: Cambridge University Press.

Moffitt, R. (1984). "Optimal Life-Cycle Profiles of Fertility and Labor Supply," **Research in Population Economics**, 5.

Newman, J. (1988). "A Stochastic Dynamic Model of Fertility." In T.P. Schultz (ed.), **Research in Population Economics** Vol 6. Greenwich, CT: JAI Press.

Olson, S. (1987). "Sweden" In P. Flora (ed.), **Limits to Growth**, Volumes 1 and 4. New York: Walter de Gruyter.

Prioux, F. (1990). "Fertility and Family Size in Western Europe," **Population** (English Selection) 2:141-162.

Tasiran, A. and B. Gustafsson (1990). "The Monthly Wage Earnings of Salesman and Shop Assistants," unpublished manuscript, University of Göteborg.

Walker, J. (1991). "The Effect of Parental Benefits on Life Cycle Fertility and Female Labor Supply," unpublished manuscript, Hoover Institution, Stanford University.

Walker, J. (1992). "A Reinterpretation of the Effect of Social Policies on Recent Fertility Behavior," unpublished manuscript, Hoover Institution, Stanford University.

Walker, J. (1994). "Sweden's Solidaristic Wage Policy and the Life Cycle Profile of Female Wages," in preparation, University of Wisconsin-Madison.

Wolpin, K. (1984). "An Estimable Dynamic Stochastic Model of Fertility and Child Mortality," **Journal of Political Economy** 92:852-871.

Table 1
Average Number of Children by Age and Cohort
For Selected Individual Birth Years

To age	1901	1911	1921	1931	1936	1940	1945	1950	1955	1960
20	0.097	0.096	0.091	0.183	0.193	0.187	0.200	0.223	0.165	0.112
25	0.633	0.409	0.577	0.815	0.814	0.860	0.857	0.837	0.684	0.548
30	1.204	0.983	1.255	1.336	1.559	1.574	1.507	1.436	1.297	1.251
35	1.626	1.503	1.689	1.774	1.945	1.915	1.825	1.806	1.771	
40	1.901	1.809	1.895	1.935	2.063	2.023	1.954	1.976		
45	2.019	1.889	1.949	1.958	2.083	2.046	1.984			
50	2.029	1.893	1.951	1.959	2.084	2.048				
Completed Fertility										
	2.029	1.893	1.951	1.959	2.084	2.048				
Estimated Completed Fertility										
							1.985	2.009	1.998	1.993

Estimated completed fertility obtained from age-specific fertility rates of 1989.

Table 2
Child Allowances 1948-1989
Nominal and Real Terms

Year	Nominal	Real	Year	Nominal	Real	Year	Nominal	Real
48	260	1003	62	550	1236	76	1800	1800
49	260	993	63	550	1201	77	1950	1749
50	260	983	64	625	1319	78	2220	1808
51	260	849	65	800	1608	79	2500	1902
52	290	879	66	900	1702	80	2850	1907
53	290	865	67	900	1629	81	3000	1791
54	290	859	68	900	1599	82	3000	1649
55	290	833	69	900	1556	83	3300	1665
56	290	797	70	900	1457	84	3300	1541
57	290	764	71	1200	1805	85	4800	2088
58	400	1005	72	1200	1704	86	4800	2004
59	400	999	73	1320	1757	87	5820	2330
60	450	1081	74	1500	1813	88	5820	2203
61	450	1055	75	1575	1734	89	5820	2072

The Consumer Price Index is used to convert nominal to real (1976) kronor.

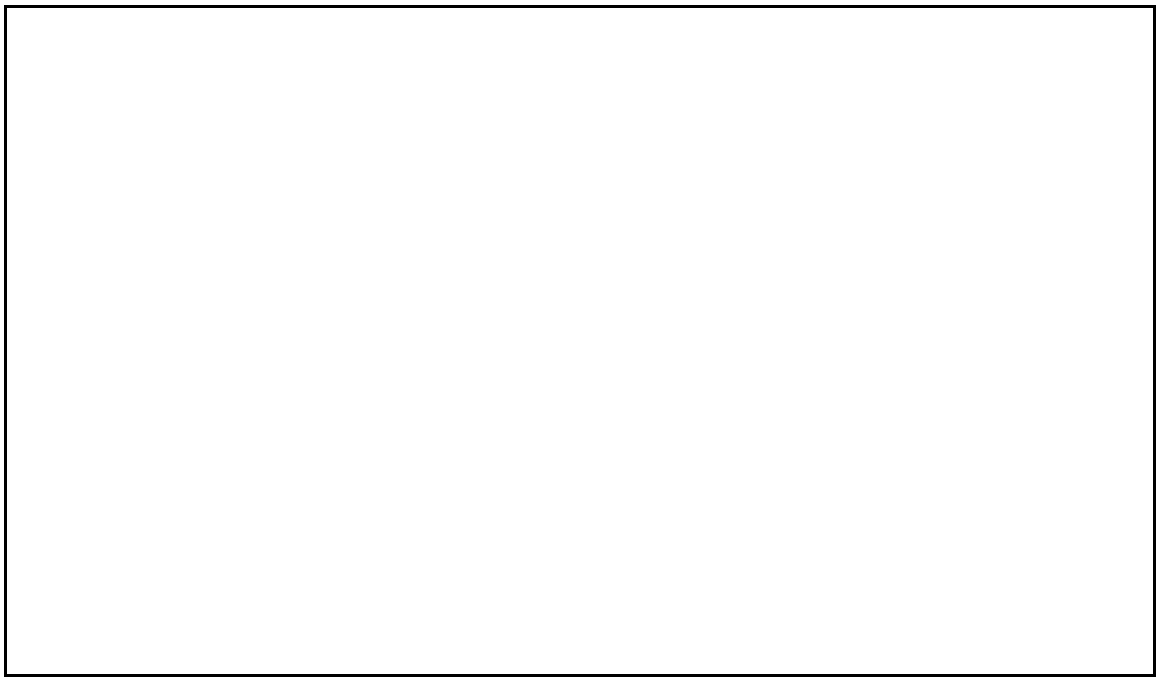

Figure 3
Log Real Short Assistant Wages
By Age and Cohort
Total Fertility Rate
1905-1990

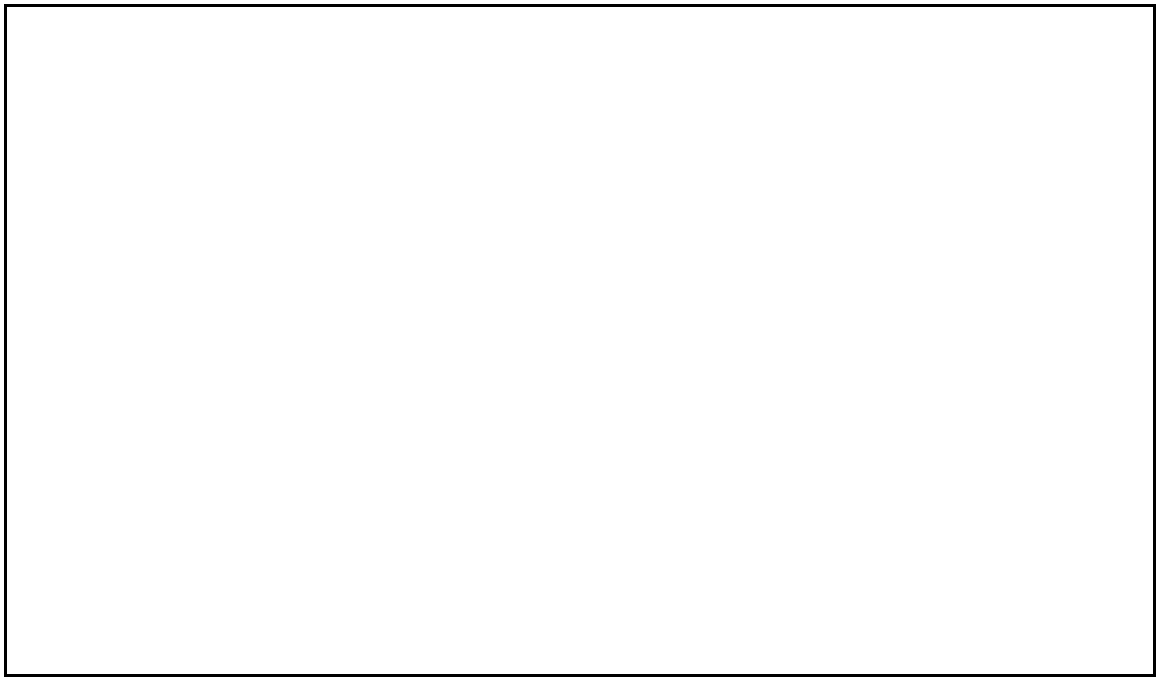

Figure 1
Age-Specific Birth Rates
1955-1990

Table 3
Components on the Shadow Price of Children

$$\pi_t = \sum_{j=0}^{T-t} ((1-\tau_{t+j}) w_{t+j} \phi^j - \theta_{t+j}) \delta_{t+j} + \sum_{j=0}^{T-t} (m_{t+j}^j - \alpha_{t+j} + (1-\phi^j) c_{t+j}^j) \delta_{t+j} + \mu_1 \sum_{j=1}^{T-t} (\sum_{l=0}^{j-1} \phi^l)(1-\tau_{t+j}) h_{t+j} w_{t+j} \delta$$

Component	Description	Value/Source
τ_t	Average Tax Rate in year t	National and Local Tax rates from Tasiran and Gustafsson (1990)
w_t	Annual earnings	Age-specific earnings for female shop-assistants from Tasiran and Gustafsson (1990).
ϕ^j	Fraction of year required for parental childcare	$\phi^0 = 1$, $\phi^j = 0.5$, $1 \leq j \leq 6$.
θ_t	Parental Insurance benefits in year t	Olson (1987) and Walker (1991).
m_t^s	Direct expenditure on child related goods for child age s	Obtained from consumer expenditure survey of 1969. See Appendix A.
α_t	Child Allowances in year t	Statistisk Årsbok 1991
c_t^s	Expenditure on childcare	A weighted average of private childcare costs and public childcare costs. Fees for public childcare from Gustafsson and Stafford (1992); private fees assumed four times the fee for public care. The weight factor equals the probability of obtaining a public childcare slot.
μ_1	Return on human capital	From Walker (1992) and Hibbs (1990): 4.1% before 1966; 2.7% 1966-75; 1.3% 1976-1989.
r	Real Interest Rate	3%
δ_t	Discount Factor	$(1+r)^{-(t-1)}$
h_t	Fraction of year t spent working	1
T	Terminal Period	Age 65

Figure 5
Full Price of Fertility
Baseline Specification Using Parameters from Table 3

Figure 6
Full-Price of Fertility
Direct Expenditures equal 20 Percent of Household Income
Full-Time Female Worker with Children

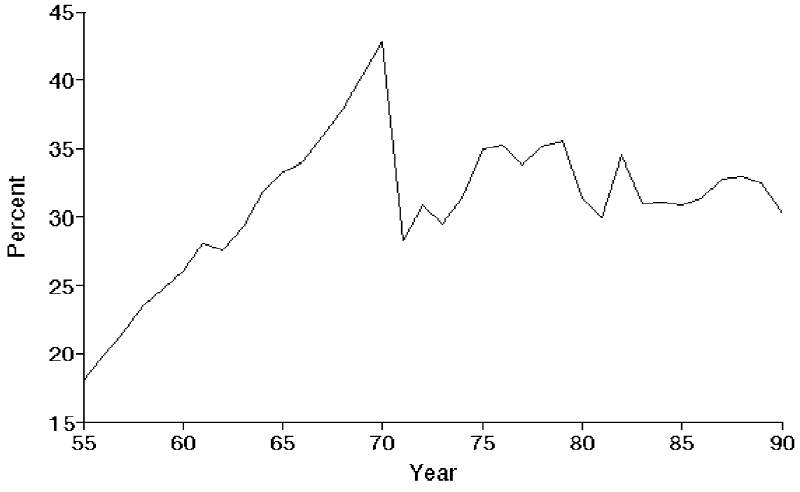

Figure 7
Robustness of the Shadow Price of Fertility
to the Length of Absence from the Labor Force

Figure 9
Robustness of Child Care Expenditures
to the Length of Absence from the Labor Force

Figure 11
Counterfactual Estimation
Wages, Taxes and Return to Human
Capital Held Constant

Figure 12
Counterfactual Estimation
Parental Benefits (PB), Public Child Care
Availability (CC),and Child Allowances (CA)
Held Constant at the 1965 (Real) Values

Figure 13
Relative Price of Fertility
Age 35 to Age 24

Note:
ER = Earnings Related
Total = Full Shadow Price

Appendix A
Estimation of Direct Expenditures on Children

This appendix describes the construction of the measure of real direct child-related expenditures. For households with the same number of adults, child-related expenditures are measured by the increased expenditures of households with children versus expenditures without children. Published data on expenditures from 1969 are used to make this comparison.[17] The top portion of Table A-1 lists household expenditures shares across broad commodity groups for households with and without children under age 16. (All expenditures are in 1969 kronor.) Households with no children spent 27,988 kronor, while households with children spent an additional 4,010 kronor, or 31,998. As expected, households with children spent substantially more on Food, Housing and Utilities and less on Alcohol and Tobacco. Information on the average household composition is reported in the middle of Table A-1. The 4,010 represents an underestimate of the direct cost of children because households with no children have more adults on average than do households with children. The rightmost column of the top portion of Table A-1 projects the household expenditure pattern of childless households from 2.42 to 2.13 adults. Childless households with 2.13 adults expend 24,638 kronor. As shown in the lower portion of the table, the direct cost of child-related expenditures then is 7,360, or 3,855 per child.

For years other than 1969, I assume no relative price changes for child-related goods and apply the Consumer Price Index to the 3,855 estimate nominal expenditures on child-related goods. By this procedure, the real (gross or before offset by child allowances) expenditures on child goods are constant.

[17] Similar but slightly lower per capita child expenditures were obtained from expenditure data from 1958. However, comparisons between the 1958 and 1969 expenditure data are not exact because the 1958 data did not give the same detail on household structure as reported in 1969.

Table A-1

1969 Household Expenditures by Household Composition

Expenditure Category	Expenditure for Household with No Children	Expenditure for Household with Children (less than 16 years old)	Predicted Expenditure for Household with Children and 2.13 Adults
Food	6542	7526	5758
Alcohol and Tobacco	1425	1404	1254
Clothing	2602	2847	2290
Housing and Utilities	4490	5811	3952
Home Furnishings	2149	2776	1891
Transportation and Communication	5381	5387	4736
Health and Personal Care	1045	1327	920
Recreation	2415	3107	2126
Sundry	1940	1812	1708
Total Expenditure	27988	31998	24638
Average Household Composition			
Number of children	0	1.91	
Number of adults	2.42	2.13	
Total Number	2.42	4.04	
Average Annual Direct Cost of Children = 31998 - 24638 = 7360			
Cost Per Child	= 7360 ÷ 1.91	= 3855	

Source:
Family Expenditure Survey of 1969, Reported in Statistical Abstract 1974.

Appendix B

Robustness of the Shadow Price of Fertility

The single most important assumption for the construction of the shadow price of fertility is the length of absence from the labor market following a birth. The sensitivity of the results to this assumption is explored and illuminated in Figures 7 through 10 reported in the text. This appendix presents graphs of the price of fertility for alternative parameterizations to exhibit the robustness of the time series pattern of the baseline specification reported in Table 3. In each of the plots the vertical axis is the shadow price (in 1976 kronor), and the horizonal axis measures calendar time. For purposes of comparison, the shadow price from the baseline model is also reported

Figure 14 shows the sensitivity of the shadow price of fertility to changes in the real interest rate. Shadow prices are calculated assuming no discounting (r=0%) and interest rates twice the assumed rate (6 versus 3 percent). As can be seen from Figure 14, the assumed interest rate has a large effect on the level but not on the times series profile of the shadow price. Figure 15 considers an increase in the terminal period (T) from age 65 to age 75. The cost of foregone human capital accumulates over a longer horizon, but because of the power of discounting over a long time interval, the net effect on the shadow price is negligible. Figure 16 considers halving the cost of private childcare from the baseline assumption of four times to twice the public rate. Again, a change in this assumption changes the level but not the time series profile of the shadow price. Moreover, the largest effect occurs earlier in the sample period and lessens as the availability of public childcare slots increases. Finally, Figure 17 plots the baseline model (Table 3) using the female manufacturing wage series in place of the shop assistant wage series. Clearly, the results are robust to the wage series used.[18] Moreover, since manufacturing wages measure wage movements among skilled workers and shop-assistant wages do so for low-skill workers, the

[18] I used the shop-assistant wages because they are age-specific, whereas the manufacturing wage series is not. Information on the changing age profile of wages is necessary for considering the relative price of fertility over the life cycle.

similarity of the shadow price series in Figure 17 for these two wage series implies that the potential selectivity bias from using an occupational specific wage series to measure the opportunity costs of employment for all workers is negligible. Indeed, there is a much larger effect from changing the interest rate from 3 to 6 percent than from using one aggregate wage series over another.

Figure 14
Robustness of the Shadow Price of Fertility
to Changes in the Interest Rate

Robustness of t
to an Increa

Figure 16
Robustness of the Shadow Price of Fertility
to a Reduction of the Cost Private Child Care to
Twice that of Public Care

Robustness of t
Baseline Model
Manufa