FERTILITY AND FEMALE LABOR-FORCE PARTICIPATION: ESTIMATES AND PROJECTIONS FOR AUSTRIAN WOMEN AGED 20-30

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FOREWORD

Sharply reduced rates of population and industrial growth have been projected for many of the developed nations in the 1980s. In economies that rely primarily on market mechanisms to redirect capital and labor from surplus to deficit areas, the problems of adjustment may be slow and socially costly. In the more centralized economies, increasing difficulties in determining investment allocations and inducing sectoral redistributions of a nearly constant or diminishing labor force may arise. The socioeconomic problems that flow from such changes in labor demands and supplies form the contextual background of the Manpower Analysis Task, which is striving to develop methods for analyzing and projecting the impacts of international, national, and regional population dynamics on labor supply, demand, and productivity in the more-developed nations.

The research on this paper began as part of a project on national econometric modeling, led by Robert Coen and Bert Hickman of the System and Decision Sciences Area at IIASA. The author, now a member of the Manpower Task in the Human Settlements and Services Area, currently is focusing on the development of models that project the interactions between demographic change, labor-force participation, and national economic performance.

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ABSTRACT

The sharp and unexpected decline in fertility rates during the 1960s and 1970s provoked a great deal of controversy. What was the cause of this decline? What will be its future path? There were two opposing schools in this debate: Becker and the "human capital" school on one side and Easterlin and his school on the other. The former emphasized that the rise in women's real wage rates drove up the opportunity cost of having children, whereas the latter emphasized the age structure of the population.

This paper presents these two lines of thought and constructs a model with ingredients from both schools. In this model the decision of having children or of entering the labor force is considered as a simultaneous one. Therefore the model tries to explain simultaneously the fertility rate and the labor-force participation rate. This structural model is then estimated for Austrian women aged 20-30 with a system estimator that takes into account the simultaneity in the model. These estimates together with some assumptions about exogenous variables are used to give some projections to the year 2000 for the endogenous variables, the fertility rates and the labor-force participation rate of women aged 20-30.

CONTENTS

FERTILITY AND FEMALE LABOR-FORCE PARTICIPATION: ESTIMATES AND PROJECTIONS FOR AUSTRIAN WOMEN AGED 20-30

After the "baby boom" in the 1950s, Western industrialized countries experienced a sharp fall in fertility rates. The reason for this decline is not obvious, and contradictory explanations have been advanced. Two leading schools of thought that are opposed in this debate are the Becker school, emphasizing the importance of women's wages as an opportunity cost of having children, and the Easterlin school, emphasizing socioeconomic factors especially the age structure of the population. Both schools presume that in developed countries, where urbanization rates are high and mortality rates are low, families can and do plan their size. This implies that fertility rates respond to the economic and sociological environment and that fluctuations in fertility become just as or more important than secular trends. In this context the factors affecting fertility and its future path raise interesting and important questions. The Easterlin school predicts a rising fertility rate in the 1980s in the United States (Easterlin 1978) whereas the Becker school predicts a continued low fertility rate (Butz and Ward 1979). The purpose of this paper is to present these two theories, to estimate the models of fertility and labor-force participation of Austrian women aged 20-30, and to give some projections to the year 2000 according to different hypotheses about the exogenous variables.

1. THE TWO THEORIES

Let me first present Easterlin's view also known as the "relative income hypothesis" (Easterlin 1978). His model not only seeks to explain the pattern of fertility, but also to develop a direct chain of causation running from the age structure of the population to the problem of stagflation.

Easterlin assumes that the labor force consists of four different groups, the first two being young and old males. Young males generally have a low skill and experience level; they engage in a considerable amount of job search causing high job turnover; and their unemployment rates are usually high. The older males are experienced and skilled and occupy the higher-level career jobs. They have a relatively low job turnover, and their unemployment rates are usually low. Easterlin assumes that the two groups are not substitutes for each other in production and that their labor-force participation rates are generally high and insensitive to labor market conditions.

The remaining two labor-force groups consist of young and old women. The assumption here is that young and old women are close substitutes for each other in production and since they typically hold "non-career" jobs, they are not substitutable for men. Furthermore men are considered as the primary "breadwinners," and their attachment to the labor force is permanent, whereas a woman's labor-force attachment is less permanent. Their primary responsibility is considered to be childbearing, child raising, and taking care of the home.

The "relative income hypohtesis" is then stated by Easterlin (1978:403) as follows: "... marriage and childbearing vary directly with the income of younger relative to older men.... The reasoning is that the relative income of younger men may be taken as a rough index of the primary breadwinner's ability to support a young household's material aspirations. These aspirations are formed by the material environment that the spouses experienced as they grew up, which depends, in turn, largely on their parent's income. Hence, when young males' income is high relative to older males', it means that they may more easily support the aspirations that they and their potential spouses formed in their families origin. Young people will then feel freer to marry and have children." The appeal of this theory is that one can draw implications from the population's structure about the performance of the economy.

An attempt has been made to explain the stagflation of the 1970s in this context (see Easterlin, 1978; Easterlin, Wachter, and Wachter, 1978). The story goes as follows. The people born during the "baby boom" in the 1950s entered the labor market in the 1970s. The large number of young people trying to find jobs created an imbalance in the labor market. The lack of job opportunities made the young people feel worse off because their aspirations were not fulfilled, so they tended to marry late and have fewer children. This explains the sharp fall in fertility. As a further consequence of young men's disappointment, young women began to enter the labor force in order to augment family incomes, thus driving their substitutes, the older women, out of the labor force (Hickman and Coen 1980).

Because of this labor-force excess and because there tends to be higher unemployment among the young, the overall unemployment rate goes up: a 1970 phenomenon. The government then orients its policy to the overall unemployment rate, undertaking expansionary fiscal and monetary actions. But the newly created aggregate demand drives up the demand for older men, since younger men cannot be substituted for them. Since older men usually have low unemployment rates, their excess demand drives up their wages, which in turn pushes up inflation.

Easterlin's hypothesis challenged that of Becker and his school - the "human capital" approach. This approach views households as utility maximizers, where market goods, leisure time, and "child services" enter the household's utility functions. The analysis is then put forward in the usual way using the same framework as the derivation of consumer demand for durable goods. As Sanderson (1976) has pointed out, the view rests on two assumptions: (1) the representative household behaves rationally on the basis of unchanging tastes, and (2) the prices of commodities desired by the representative household are unaffected by that household's consumption decisions. Easterlin rejected the first postulate and replaced it by a mechanism through which tastes (aspirations) change systematically according to one's upbringing. In the course of the debate Becker abandoned assumption (2) and maintained that the relative prices of children and the relative price of goods consumed per child are not independent of household decisions. He reasoned that the family cares about its average level of expenditures per child, but not about its expenditures on each child separately. As parent's income increases they are assumed to want to spend more both on themselves and on each of their children.

Both the Easterlin and Becker schools assume that, when enough factors are left constant, the underlying relation between fertility and income is positive, but they proceed to show that when income changes, something else is likely to change that has an offsetting effect on fertility. The major source of these different offsetting forces is its nature not its existence. According to the Easterlin group the force that offsets the underlying positive income effect is related to parent's aspirations for their own standard of living. Over time, both current income levels and aspiration levels rise, leaving the net effect of these two forces unclear. According to the Becker group, the offsetting force is related to parents' aspirations for their children's material standard of living. As parent's income rise, they want to increase their average expenditure per child, thus increasing the cost to them of an appropriately raised child. The increasing cost of children with higher standards of living, therefore, would offset the effect of higher income.

In recent years the differences between the Easterlin and Becker schools has narrowed considerably. Sanderson (1976:473) wrote: "The two specifications differ not only in that, holding other things constant, the Becker group expects the desired level of expenditures per child to be positively related to parental income, while the Easterlin group expects desired bequests (and expenditures) per child to be independent of parental income." By introducing the notion of "child quality" the Becker group moved close to Easterlin's position. "Child quality" depends on the level of expenditures per child and on a host of other influences over which the parents have little or no control. This extension allows the Becker school to analyze fertility also in an intergenerational context. To see how close the two positions may be, Sanderson (1976:473) quotes the following words of Becker: "Our conclusions about the effect of economic growth on the number of children are similar to those reached by Richard Easterlin in his important work on fertility.... Both Easterlin's and our own analysis are based on changes in the economic position of children relative to their parents."

2. THE MODEL

The empirical model described in this paper is based on a model first presented by Butz and Ward (1979) but with more attention given to labor-force participation. The model includes Easterlin's relative income hypothesis and at the same time follows Becker's line of thought of households being utility maximizers.

Here the emphasis is placed on the assymmetry between an increase in men's wages and an increase in women's wages. Since women's time is considered to be important "input" in the production of children's services whereas men's time is not, women's wages can be viewed as an opportunity cost of having children. For a household with an employed wife, an increase in a man's income raises family income and leads to a higher demand for children. An increase in a woman's wages also contributes to an increase in family income, which, in turn, leads to a higher demand for children. This income effect, however, is offset by the simultaneous increase in the opportunity cost of child-bearing and rearing. So far as families with employed wives are concerned, the probability of having a child in a given year, B, depends on the male's income, Ym, on the female's wages, Wf, and on other factors, X. By using the male's income instead of the male's wage rate it is assumed that the hours worked by men are exogenous to the model.

$$B = B1(Ym, Wf, X) \qquad \text{if wife is employed} \tag{1}$$

When both husband and wife are employed, an increase in the husband's wage will induce the wife to reduce her hours in the labor market. An increase in the wage of a husband whose wife is not employed will increase her reservation wage, $\tilde{W}f$, which in turn increases the shadow price of children. The desire of a nonemployed wife to have children, then, is a function of Ym, $\tilde{W}f$, and X:

$$\begin{aligned} B &= B2[Ym, \tilde{W}f(Ym), X] \qquad \text{if wife is nonemployed} \\ &= B2(Ym, X) \end{aligned} \tag{2}$$

A change in the birth rate induced by a change in women's labor-force participation can be measured as an average of the response in three classes: nonemployed, employed, and transitional. For wives who change their employment status in response to a wage change, the induced change in B, the probability of childbearing, is a fraction of that exhibited by women who remained employed. This fraction will be denoted by a. It is a function of how close the initial market wage is to the reservation wage of a representative woman. Given these considerations and denoting K as the labor-force participation rate of women, the total differenciation of B leads to:

$$\begin{aligned} d\,B &= K \frac{d\ B1}{d\ Wf}\, d\ Wf + a\,\Delta\,K \frac{d\ B1}{d\ Wf}\, d\ Wf \\ &= K \frac{d\ B1}{d\ Wf}\, d\ Wf + a \frac{d\ K}{d\ Wf} \frac{d\ B1}{d\ Wf}\, (d\ Wf)2 \end{aligned} \tag{3}$$

The response to an increase in a husband's wage is then given by

$$dB = K \frac{d\ B1}{d\ Ym} d\ Ym + (1 - K) \frac{d\ B2}{d\ Ym} d\ Ym + \tag{4}$$

$$+ \left[a \frac{d\ B1}{d\ Ym} + (1 - a) \frac{d\ B2}{d\ Ym} \right] \frac{d\ K}{d\ Ym} (d\ Ym) 2$$

Dropping the "small" squared differentials, combining equations (3) and (4) and writing the result in elasticity form gives

$$d \ln(B) = \left[\frac{B1}{B} e(B1, Ym) * K * d \ln(Ym) \right] + \left[\frac{B2}{B} e(B2, Ym) \right] \tag{5}$$

$$* (1 - K) * d \ln(Ym) + \left[\frac{B1}{B} e(B1, Wf) \right] * K * d \ln(Wf)$$

where

e(.,.) represents an elasticity.

This will give

$$\ln(B) = b0 + b1*K*\ln(Ym) + b2*(1 - K)*\ln(Ym) + \tag{6}$$

$$+ b3*K*\ln(Wf)$$

with $b1 > 0$, $b2 > 0$, and $b3 < 0$.

Finally, collecting the K*ln(Ym) terms leads to:

$$\ln(B) = g0 + g1*K*\ln(Ym) + g2*\ln(Ym) + g3*K*\ln(Wf) \tag{7}$$

with $g0 = b0$, $g1 = b1 - b2$, $g2 = b2$, $g3 = b3$.

Therefore, the expected signs of equation (7) are:

$g1 + g2 > 0$ and $g3 < 0$

Consider now a rise in the earnings of all participants. If K is low, it will have a positive effect on B. On the other hand, if K is high, the effect will be reduced or even become negative. When K is low, then, periods of high income periods are associated with high fertility periods. When, on the contrary, K is high (as it has been in recent years), high income periods are associated with low fertility periods. This implies that fertility will behave countercyclically.

Since this model emphasizes the interrelationship between fertility and the labor-force participation of women, a second equation specifying this participation is added to equation (7) to complete the model. In their paper Butz and Ward (1979:322 and footnote 11) are not precise about the second equation, even though they use a system's estimation procedure (two-stage least squares). In this work an equation of the following type is specified:

$$K = c0 + c1*\ln(B) + c2*\ln(Wf) + c3*EQ + c4*TIME + c5*K(1) \quad (8)$$

where

K — is the labor-force participation rate of women

EQ — is the overall labor-force participation standing as a proxy for the level of economic activity*

TIME — is the linear time trend capturing the change of the woman's position in society

K(1) — K lagged on year

*Other variables, like the deviation of GNP from trend or the unemployment rates, were also tried in order to capture the level of economic activity. But it turned out that they have either the wrong sign or are statistically insignificant.

To capture his relative income hypothesis, Easterlin proposed a variable based on the notion that a population having fewer younger males than older males is in a better economic position to encourage having children than the reverse. His variable, MR, therefore represents the ratio of males aged 15 to 35 years over males aged 35 to 65 years. When MR is low there should be a positive effect on fertility and a negative effect on the labor-force participation of women. This variable will be introduced into both equation (7) and (8) of the basic model in order to test the relative income hypothesis. This variable was used successfully by Hickman and Coen (1980) in their model, which determined women's labor-force participation rates.

3. THE ESTIMATES

The analysis for this paper was carried out for women 20 to 30 years of age, thus giving B and K age-specific values. More details about the variables used and their source can be found in the Appendix. The data cover 22 annual observations from 1957 to 1978. Equation (7) is first estimated by ordinary least squares (OLS) and the results are reported in Table 1. All coefficients have the hypothesized signs and are highly significant.

Let us now consider what the addition of the Easterlin variable MR will do to the equation. The result is also reported in Table 1. Obviously the fit of the equation has improved considerably. What seems more important is that the autocorrelation in the equation has practically disappeared. This supports the view that the Easterlin variable captures a different aspect of the fertility pattern. Since the age structure of the population changes more slowly, it explains the medium-term behavior, whereas the other variables, which are related to business cycles, capture more of the short-term movements. This would imply that there is no contradiction between the Becker and the Easterlin approach, since they refer to different time horizons for the fertility behavior.

Table 1. OLS estimation results for the fertility equation (7); the dependent variable is ln(B).

Equation (7)	Constant	K*ln(Ym)	K*ln(Wf)	ln(Ym)	MR	DW	RHO(1)	SE	MAPE	R^2	R^2_c
Without Easterlin hypothesis	3.64059	.02172	-.05533	1.88117		1.206	.37	.03724	.58	.951	.943
	(12.26)	(3.21)	(6.24)	(5.99)							
Easterlin hypothesis included	4.70292	.01860	-.04976	1.93381	-1.31959	1.748	.08	.03167	.48	.966	.959
	(10.34)	(3.18)	(6.38)	(7.22)	(2.81)						

DW = Durbin-Watson statistic

RHO(1) = estimated first order autocorrelation coefficient

SE = standard error of the error term of the equation

MAPE = mean absolute percentage error

R^2_c = R^2 corrected for the degrees of freedom

the number in parentheses under the coefficient is the corresponding t-statistic

The estimation of the labor-force participation equation (8) is more difficult, since the coefficients are not as significant*. The results are given in Table 2. Let us first consider the variant including all relevant variables. The overall statistics are satisfactory, but four of the seven coefficients are not significant. The procedure followed now is to drop one or more of the insignificant variables. When K(1) is dropped all coefficients except the constant term become significant, and the overall statistics are either improved or remain the same. This suggests that multicollinearity was present in the first equation estimated. Removing the constant term also improves the fit of the equation: the Durbin-Watson coefficient, DW, the standard error, SE, and the corrected R2. This will be the preferred equation, which will be used for further calculations. The inclusion of MR in the equation seems to be crucial, since the fit of equations not including MR is much worse. Another indication that MR should be included is that the coefficient of ln(B) nearly doubles when MR is excluded, implying that the effect of MR is partly dependent upon ln(B).

Since the theory behind this model stresses the interrelationship between fertility and labor-force participation behavior of women, the two equations (7) and (8) form a system, which should be estimated simultaneously. The degree of overidentification is not high thus causing the two stage least squares (TSLS) to be identical or dominate the limited information maximum likelihood (LIML) for small samples. The results of these two estimators are shown in Table 3. The results show no significant difference to the one obtained by OLS. This indicates that the degree of misspecification in both equations is not high, since the OLS estimation is much more robust to such failures. For further analysis we therefore use the results obtained by TSLS.

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*For an overview of the behavior of Austrian labor-force participation rates, I refer to an article by Biffl (1979).

Table 2. OLS estimation results for labor-force participation equation (8).

Constant	ln(B)	ln(Wf)	EQ	MR	TIME	K[1]	DW	RHO(1)	SE	MAPE	R^2	R_c^2
31.94226	-8.0604	-61.9552	.55851	32.92903	2.44554	.13767	2.484	-.25	.82998	.84	.872	.821
(.94)	(2.57)	(3.66)	(1.23)	(1.85)	(3.42)	(.64)						
22.52400	-7.60215	-69.26828	.74238	36.48505	2.76233		2.298	-.16	.81449	.85	.869	.828
(.75)	(2.53)	(5.65)	(2.16)	(2.20)	(5.46)							
	-5.97677	-68.17235	.90451	39.91117	2.71481		2.199	-.12	.80383	.86	.864	.833
	(2.93)	(5.68)	(3.43)	(2.54)	(5.48)							
55.40148	-10.555	-40.01278	.66390		1.62170	.26227	2.198	-.13	.89060	.90	.843	.794
(1.63)	(3.47)	(3.08)	(1.37)		(2.70)	(1.19)						
40.86394	-10.15625	-50.45102	1.07616		2.10274		1.777	.09	.90171	.96	.829	.789
(1.27)	(3.22)	(5.19)	(3.15)		(4.66)							

DW = Durbin-Watson statistic

RHO(1) = estimated first order autocorrelation coefficient

SE = standard error of the error term of the equation

MAPE = mean absolute percentage error

R_c^2 = R^2 corrected for the degrees of freedom

the number in parentheses under the coefficient is the corresponding t-statistic

Table 3. TSLS and LIML estimation results for the equation system (7) and (8).

Fertility equation

Constant	K*ln(Ym)	K*ln(Wf)	ln(Ym)	MR	DW	RHO(1)	SE	MAPE	R^2	Estimation Procedure
4.75501 (10.37)	.01797 (2.98)	-.04859 (6.15)	1.89909 (6.66)	-1.33907 (2.84)	1.711	.10	.03169	.48	.966	TSLS
4.75653 (10.37)	.01795 (2.98)	-.04856 (6.15)	1.89809 (6.64)	-1.33964 (2.84)	1.710	.10	.03170	.48	.966	LIML 1=1.027858

Labor-force participation equation

ln(B)	ln(Wf)	EQ	MR	TIME	DW	RHO(1)	SE	MAPE	R^2	Estimation Procedure
-5.89503 (2.65)	-68.32956 (5.64)	.89628 (3.22)	40.09417 (2.53)	2.72273 (5.42)	2.197	-.12	.80386	.86	.864	TSLS
-5.89270 (2.64)	-68.33146 (5.63)	.89608 (3.22)	40.09598 (2.53)	2.72286 (5.42)	2.197	-.12	.80387	.86	.864	LIML 1=1.03953

DW = Durbin-Watson statistic

RHO(1) = estimated first order autocorrelation coefficient

SE = standard error of the error term of the equation

MAPE = mean absolute percentage error

R^2_c = R^2 corrected for the degrees of freedom

the number in parentheses under the coefficient is the corresponding t-statistic

instruments used: ln(Ym), MR, constant, ln(Wf), TIME, EQ

4. MULTIPLIER ANALYSIS

It is interesting to see the total effect that certain exogenous variables have on the two endogenous variables: the fertility rate and the labor-force participation rate of women between the ages of 20 and 30. Let us first calculate the elasticity of B with respect to Ym, Wf, and MR:

$$\frac{d\ \ln(B)}{d\ \ln(Ym)} = .01797*K + 1.89909 \tag{9}$$

$$\begin{aligned}\frac{d\ \ln(B)}{d\ \ln(Wf)} &= .01797*(-68.32956)*\ln(Ym) - .04859*K \\ &\quad + (-.04859)(-68.32956)*\ln(Wf) \qquad (10) \\ &= -1.22788*\ln(Ym) - .04859*K + 3.32013*\ln(Wf)\end{aligned}$$

$$\begin{aligned}\frac{d\ \ln(B)}{d\ MR} &= .01797*40.09417*\ln(Ym) - 1.33907 \\ &\quad - .04859*40.09417*\ln(Wf) \qquad (11) \\ &= .72049*\ln(Ym) - 1.94818*\ln(Wf) - 1.33907\end{aligned}$$

In the same way one can derive the multipliers for K with respect to Ym, Wf, and MR:

$$\begin{aligned}\frac{d\ K}{d\ \ln(Ym)} &= -5.89503*.01797*K \\ &\quad -5.89503*1.89909 \qquad (12) \\ &= -.10593*K - 11.19519\end{aligned}$$

$$\frac{d\ K}{d\ \ln(Wf)} = (-5.89503)*(-.04859)*(-68.32956)*\ln(Wf)$$

$$+(-5.89503)*(-.04859)*K* - 5.89503*.01797$$

$$* (-68.32956)*\ln(Ym) - 68.32596 \qquad (13)$$

$$= - 19.57229*\ln(Wf) + .28644*K$$

$$+ 7.2384*\ln(Ym) - 68.32596$$

$$\frac{d\ K}{d\ MR} = 40.09417 + 5.89503*1.33907 = 47.98803 \qquad (14)$$

These elasticities are not constant because of the nonlinearities present in the system. The results for some specific years are shown in Table 4. The elasticity of B with respect to Ym remained fairly constant over time, whereas the elasticity of B with respect to Wf showed the expected negative sign but declined over time. Since the influence of Wf on K also declined, the effect of a change in Wf became less important. The reverse phenomena can be observed with regard to the influence of the variable MR, which became more and more important with respect to B and remained constant with respect to K. This fact supports the Easterlin hypothesis and implies that it is important for projections of fertility rates (see Lee 1976).

5. PROJECTIONS TO THE YEAR 2000

To make projections, some hypotheses concerning the future path of the exogenous variables have to be made. Since MR is the ratio of males between 15 and 35 years of age over the males between 35 and 65 years of age, the fertility projection of 1979 will begin to affect MR only after 1994. Despite this all the values of this variable up to the year 2000 are treated as exogenous. They are calculated from the projections up to the year 2010

Table 4. Elasticities and multipliers for specific years.

	$\frac{d \ln(B)}{d \ln(Ym)}$	$\frac{d \ln(B)}{d \ln(Wf)}$	$\frac{d \ln(B)}{d MR}$	$\frac{d K}{d \ln(Ym)}$	$\frac{d K}{d \ln(Wf)}$	$\frac{d K}{d MR}$
1960	3.148	-3.220	-1.431	-18.557	-49.346	47.988
1965	3.078	-2.527	-1.727	-18.144	-53.429	47.988
1970	3.056	-1.922	-2.048	-18.017	-56.997	47.988
1975	3.126	-1.601	-2.347	-18.430	-58.887	47.988
1978	3.162	-1.511	-2.457	-18.642	-59.417	47.988
mean (1960-78)	3.108	-2.176	-1.980	-18.321	-55.496	47.988

done by the Austrian Statistical Bureau. The variable EQ does not vary much and its importance is limited; no special assumption is therefore made for it. EQ is set equal to its 1978 value, 72.0%, for the rest of the century. For the remaining variables, Ym, Wf, and TIME, different assumptions are made. For TIME two cases are considered: a continuation of the upward trend of women's position in society to 1999 and a slowdown of this trend. The growth rate of Ym, the real monthly earnings of men, is taken to be equal to the medium-term projections done by the Institute for Advanced Studies (1980) in Vienna for the years 1980 to 1986. After this year two variants are considered: a "low" variant with a constant 2% real growth rate of men's monthly earnings and a "high" variant with a .3% growth rate. Women's real monthly earnings, Wf, are assumed to follow basically men's growth rates. But in some cases a 3% per annum faster increase of Wf is analyzed. The values of the exogenous variables are shown in Table 5.

Tables 6 and 7 give the simulations with different growth rates of earnings but with no slowdown in the time trend. The consequence of these assumptions is that labor-force participation rises from 70% in 1978 to more than 90% in some cases at the end of the century. These high participation rates induce incredibly low fertility rates reaching a minimum of less than 50%. But despite these results some interesting insights can be gained from these projections. All variants predict a further fall in the fertility rate until a minimum is reached at the beginning of the 1990s. For the "low" variant no recovering of the fertility rate is predicted up to the year 2000. But for the "high" variant the model predicts an upswing of fertility rates starting in 1993 and continuing thereafter. This indicates that there is imbedded in the model a possibility of higher fertility rates in the future. For the labor-force participation the reverse can be said, since it mirrors the behavior of the fertility rate. As one can see from Tables 6 and 7, a variant with a .3% higher growth rate of a female's real monthly earnings were tried. The idea is that women's earnings tend to catch up

Table 5. Assumptions about exogenous variables.

	EQ	MR	%increase in real monthly earnings		TIME	
			low	high	not slowed down	slowed down
1979	72.0	.9337			29.0	28.9
1980	72.0	.9432	.2	.2	30.0	29.0
81	72.0	.9491	2.2	2.2	31.0	29.7
82	72.0	.9386	1.6	1.6	32.0	30.3
83	72.0	.9226	1.2	1.2	33.0	30.9
84	72.0	.9124	1.5	1.5	34.0	31.4
85	72.0	.9072	2.5	2.5	35.0	32.0
86	72.0	.9049	1.7	1.7	36.0	32.4
87	72.0	.9023	2.0	2.0	37.0	33.1
88	72.0	.8958	2.0	2.5	38.0	33.6
89	72.0	.8870	2.0	3.0	39.0	34.2
1990	72.0	.8763	2.0	3.0	40.0	34.9
91	72.0	.8619	2.0	3.0	41.0	35.7
92	72.0	.8443	2.0	3.0	42.0	36.6
93	72.0	.8261	2.0	3.0	43.0	37.6
94	72.0	.8067	2.0	3.0	44.0	38.6
95	72.0	.7851	2.0	3.0	45.0	39.6
96	72.0	.7612	2.0	3.0	46.0	40.6
97	72.0	.7356	2.0	3.0	47.0	41.6
98	72.0	.7101	2.0	3.0	48.0	42.6
99	72.0	.6846	2.0	3.0	49.0	43.6

Table 6. Projections to the year 2000.
Assumptions: TIME not slowed down, low growth rates of real earnings.

	.0% difference in growth rates		.3% difference in growth rates	
	B	K	B	K
1979	102.78	71.0	102.78	71.0
1980	92.68	74.2	92.14	74.0
81	87.67	75.5	86.64	75.2
82	84.67	76.9	83.15	76.4
83	82.42	78.3	80.41	77.7
84	77.81	80.4	75.35	79.6
85	73.46	82.1	70.65	81.1
86	67.50	84.4	64.37	83.4
87	63.36	86.1	59.94	84.8
88	60.10	87.5	56.41	86.1
89	57.32	88.8	53.38	87.2
1990	54.92	90.0	50.74	88.3
91	53.19	91.0	48.78	89.1
92	52.02	91.8	47.37	89.7
93	50.93	92.6	46.05	90.4
94	50.00	93.3	44.96	90.9
95	49.50	93.8	44.16	91.3
96	49.30	94.3	43.73	91.6
97	49.39	94.6	43.57	91.7
98	49.44	94.9	43.40	91.9
99	49.47	95.3	43.21	92.1

Table 7. Projections to the year 2000.
Assumptions: TIME not slowed down, high growth rates of real earnings.

	.0% difference in growth rates		.3% difference in growth rates	
	B	K	B	K
1979	102.78	71.0	102.78	71.0
1980	92.68	74.2	92.13	74.0
81	87.66	75.5	86.63	75.2
82	84.66	76.9	83.15	76.4
83	82.41	78.4	80.40	77.7
84	77.80	80.4	75.35	79.6
85	73.45	82.1	70.63	81.1
86	67.50	84.4	64.35	83.4
87	63.35	86.1	59.93	84.8
88	60.64	87.1	56.96	85.7
89	58.96	87.7	55.07	86.1
1990	57.60	88.1	53.52	86.3
91	56.94	88.3	52.67	86.3
92	56.92	88.3	52.45	86.2
93	56.95	88.2	52.40	85.9
94	57.35	88.1	52.62	85.6
95	58.27	87.9	53.34	85.2
96	59.71	87.5	54.73	84.6
97	61.67	87.0	56.61	83.9
98	63.76	86.4	58.63	83.1
99	66.10	85.9	60.85	82.4

with men's earnings. The qualitative results do not change, but the levels of B and K change substantially. The fertility rate and labor-force participation are lower in both the "low" and the "high" variant.

To bring more realism into the projections the time trend is slowed, thus bringing labor-force participation down to values that are "near" to other projections (Biffl 1979). This arbitrary action of modifying the time trend in such a way can only be justified on pragmatic grounds. It is one way to incorporate other information not captured by the model or to reflect the ideas of the scientist. The new projections with the modified time trend is shown in Tables 8 and 9. Now the picture is more realistic. The fertility rate falls slightly but levels off in the beginning of the 1980s and varies around the 100% level until the end of the 1980s. At this point the fertility rate starts to rise in the case of "high" growth rates and remains around the 100% level in the case of "low" growth rates until the end of the 1990s when it starts to rise. The labor-force participation rate, on the other hand, rises until the mid-1980s and then begins to fall dramatically to around 66% in the case of "high" growth rates with no difference between male and female growth rates. For the variants with "low" growth rates a further increase in K is projected up to the year 1999, at which point it reaches a maximum of 76% when there are no differences in the growth rates and 72.5% when female's earnings grow at a 0.3% higher rate than those of males.

6. CONCLUSIONS

As the projections have shown, the model can create swings in labor-force participation and fertility rates. Since these swings are related to a great extent to the MR variable, cycles with about a 20 year duration are generated. Theoretically this has been examined by Paul Samuelson (1976), who constructs a model, where fertility waves are generated endogenously. But the arbitrariness of the time trend and its large influence allows too many variations in the future paths of the endogenous

Table 8. Projections to the year 2000.
Assumptions: TIME slowed down, low growth rates of real earnings.

	.0% difference in growth rates		.3% difference in growth rates	
	B	K	B	K
1979	103.72	70.7	103.72	70.7
1980	101.86	70.9	101.24	70.7
81	99.39	71.2	98.43	70.9
82	100.10	71.3	98.31	70.8
83	101.66	71.4	99.56	70.7
84	101.36	71.8	98.90	70.9
85	100.57	72.0	97.76	71.0
86	99.18	72.4	95.98	71.2
87	97.10	73.0	93.58	71.6
88	98.25	72.7	94.43	71.1
89	99.16	72.5	95.14	70.8
1990	99.77	72.6	95.32	70.7
91	100.28	72.8	95.75	70.7
92	100.69	73.2	95.82	70.9
93	100.05	73.9	94.92	71.4
94	99.66	74.5	94.28	71.8
95	99.97	75.0	94.35	72.1
96	101.06	75.3	95.30	72.3
97	102.75	75.6	96.73	72.3
98	104.42	75.8	98.22	72.4
99	106.06	76.1	99.72	72.4

Table 9. Projections to the year 2000.
Assumptions: TIME slowed down, high growth rates of real earnings.

	.0% difference in growth rates		.3% difference in growth rates	
	B	K	B	K
1979	103.72	70.7	103.72	70.7
1980	101.86	70.9	101.24	70.7
81	99.39	71.2	98.43	70.9
82	100.10	71.3	98.31	70.8
83	101.66	71.4	99.56	70.7
84	101.36	71.8	98.90	70.9
85	100.57	72.0	97.76	71.0
86	99.18	72.4	95.98	71.2
87	97.10	73.0	93.58	71.6
88	99.37	72.3	95.72	70.7
89	102.98	71.3	99.08	69.5
1990	106.15	70.6	102.27	68.6
91	109.80	70.0	105.87	67.8
92	113.60	69.5	109.50	67.1
93	116.41	69.3	112.35	66.7
94	119.79	69.1	115.84	66.3
95	124.36	68.7	120.62	65.7
96	130.38	68.2	127.27	64.9
97	138.02	67.5	135.31	64.0
98	146.09	66.9	144.16	63.1
99	154.88	66.2	153.99	62.2

variables. This reduces the credibility of the projections. One way to improve the model is to eliminate the time trend and present a "better" equation for labor-force participation. An improvement would be the use of mean monthly earnings of females; a female wage rate seems more appropriate. This was unfortunately impossible with Austrian data. The use of such a variable and the increasing importance of part-time jobs suggests the introduction in some way of the number of hours worked by women.

Another problem with this model is the question of how age structure of the population determines wages. According to Easterlin's hypotheses, young and old males are not substitutes for each other in production, and their wages should be determined separately. This is one direction in which the model can be further improved.

The Becker school explains fertility by variables, which, like real wages and labor-force participation, varies with the business cycle. Their model, therefore, can only explain the "timing" of having children. "Good" times economically are associated with high wages for women, which drives up the opportunity costs of having children and thereby lowers fertility rates. But when the economy moves from a boom period to a depression, thereby lowering these opportunity costs, fertility rates will rise, according to their model. This means that women postpone their births to times that are not so good economically.

The number of children a women wants to have in her life, however, is not affected. The number of "desired" children is related to long-term considerations. It seems that Easterlin's variable MR can capture this effect. This would mean that two theories do not contradict each other, but the supplement each other. The Becker theory explains the short-run movements in the fertility rate whereas the Easterlin theory explains the medium- and long-run movements.

Since sociological factors as well as economic factors appear to be of importance, the incorporation of other variables reflecting the socioeconomic environment will be necessary; in such modeling Easterlin's MR variable is a step in this direction.

APPENDIX

B = fertility rate of women aged 20 to 30 years. Source: Demographisches Jahrbuch Oesterreichs 1978, Beitrage zur Oesterreichischen Statistik, Heft 546, Oesterreichisches Statistisches Zentralamt (Demographic Yearbook of Austria 1978, Reports on Austrian Statistics No.546, Austrian Statistical Bureau)

EQ = labor-force participation of all ages and sexes. Source: WIFO, Volkswirtschaftliche Datenbank (Austrian Institute for Economic Research)

K = labor-force participation of women aged 20 to 30. Source: WIFO, Volkswirtschaftliche Datenbank (Austrian Institute for Economic Research)

MR = males aged 15 to 35 years over males aged 35 to 65 years. Source: Demographisches Jahrbuch Oesterreichs 1978, Beitraege zur Oesterreichischen Statistik, Heft 546, Oesterreichisches Statistisches Zentralamt (Demographic Yearbook of Austria 1978, Reports on Austrian Statistics No.546, Austrian Statistical Bureau)

TIME = linear time trend starting in 1950

Wf = mean monthly real earning of women. Source: Oesterreichisches Statistisches Zentralamt (Austrian Statistical Bureau)

Ym = mean monthly real earning of men. Source: Oesterreichisches Statistisches Zentralamt (Austrian Statistical Bureau)

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