Variations in Fertility - a Consequense of Other Factors Besides Love?

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May 22, 2006

Abstract

The purpose of this paper is to discuss possible explanations for the variation in the Swedish fertility rate. We are primarily interested in economic and social conditions and their impact on the total fertility rate between 1965 and 2003. The results from the study support a positive effect on fertility from the female labour market participation and child allowance while divorces report a negative effect on fertility. The model including level as well as differences in the variables has been found to give the best results.

Key Words: Total fertility rate; Economics; Sweden; Time-series

JEL Classification: D19; J13

*The authors would like to thank Jonas Nordström and Magnus Wikström for valuable comments and suggestions.

†The financial support from the Swedish council for working life and social research is gratefully acknowledged.

1 Introduction

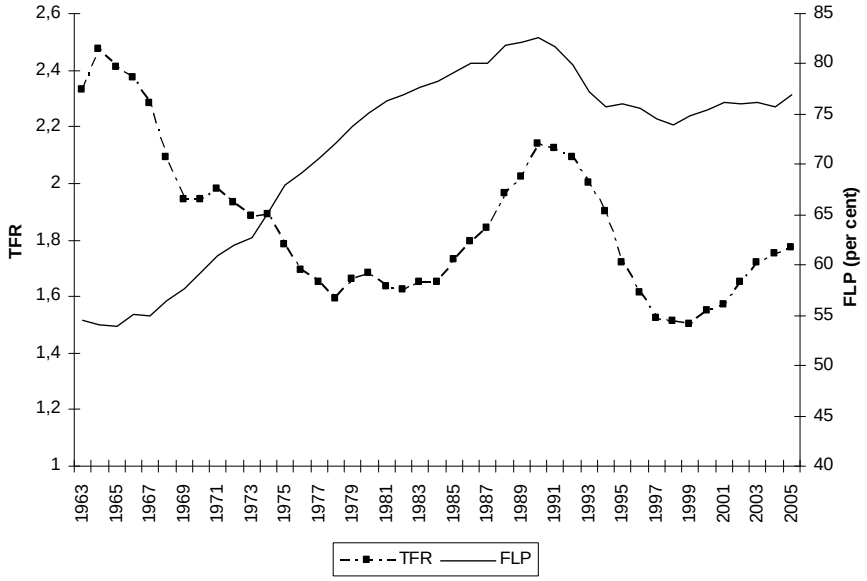
In the process of becoming a parent today there are many more factors involved than ever before. A low or high level of fertility may therefore be an effect of actual macroeconomic situations as well as different conditions on the micro level. Social infrastructure, level of social welfare, labour market situation for both women and men, together with current trends among young people and their life-style in general may all have an impact on fertility.

One historical factor of special significance is of course the transition of women from being primarily (unpaid) household workers to be a considerable part of the paid labour force in Sweden. The development since the 1960s has been increasing employment among women and strong variations in fertility. In the beginning the correlation was negative i.e. increasing female labour market participation and decreasing fertility rate (see figure 1 below). The explanations of the negative relationship were many e.g. lack of facilities which made it almost impossible for mothers to combine paid work and children in a reasonable way. Very limited supply of childcare is perhaps the best example here. Another explanation has to do with traditional gender roles. Despite the fact that more and more women became "bread-winners" their main responsibility for the children (and family) remained unchanged. A third reason may be rising opportunity costs. As soon as women became a part of the paid labour force a "cost" was associated with becoming a mother since she had to leave the market, temporarily or permanently. The paid parental leave, introduced in 1974, was a way to mitigate this.

In the beginning of the 1980s the relation between female participation and fertility did change. From being negative for a long time it suddenly became positive. During the 1980s female employment rate as well as fertility rate did increase simultaneously. The peak was reached in 1991. At that point of time fertility in Sweden was among the highest in the western world and so was the female employment rate, 2.14 and 80 percent respectively.[1] After 1991 these two rates fell quite dramatically. The reason was primarily the severe economic crisis that hit Sweden at that time. The employment rate fell, the unemployment rose and the drop in fertility was substantial. By the end of the 1990s the fertility rate reached a historical minimum at 1.5. This negative trend did however come to an end with the new millennium and since then there has been a rise in female employment rate as well as in fertility rate. In 2005 the former was approximately 77 percent and the latter 1.77.

[1] Ireland and Iceland were the only countries with a higher TFR.

Fig. 1: Total fertility rate and female labour market participation in Sweden, 1963-2005



Source: Statistics Sweden (SCB)

The purpose of this paper is to find out reasonable causes behind the variations in fertility in Sweden during the period 1965-2003. The question of specific interest is: What impact does the female labour market participation have on the fertility rate during this period? The period 1965-2003 is chosen simply because a very distinct pattern for female participation and fertility and secondly because it shows the contrasting relationship, first negative and then positive, between the two variables.

The structure of the paper is as follows. The next section presents the theoretical considerations. In section 3 the model, empirical specification and the data are presented. The results are presented in section 4 and in section 5 the paper is summarized.

2 Theoretical considerations

2.1 The traditional economic theory of fertility

The underlying assumption in the economic analysis of fertility is that households are rational economic units that act optimally in any given situation and that the intentions of the two partners in the household will therefore always

be equal.[2] The child is assumed to provide a utility to the household which is compared to that of other goods via the family utility function. The parents' expenditures for their children's upbringing can be divided into two parts: *direct costs* associated with the children's food, clothes, toys etc., *indirect costs* related to the time-consuming effect of children on their parents' time. Population economics focuses mainly on the indirect costs, which are correlated with the income the parents must give up by spending time bringing up their children. The higher the wage rate, the more expensive it will be not to work. If the spouses freely allocate their time between labour market activities and child care, an economically rational choice is to let the individual who earns less spend all her/his time at home raising the children. Since women on average earn less, and reinforced by tradition and existing gender contracts, they are in many cases expected to take the main responsibility for the household work and the children. When the female wage rate exceeds the reservation wage, the supply of female labour increases and the opportunity cost of children raises. The economic theory of fertility therefore assumes a negative relationship between female supply and observed fertility (see Leibenstein 1957; Becker 1960, 1965, Mincer 1963).[3]

2.2 Female labour market participation and fertility

The support for a negative relationship has, as stated earlier, become weaker in most countries over recent decades (see e.g. Ahn et al., 2002; Engelhardt et al., 2004; Kögel, 2004). In Sweden the female labour market participation rate and the fertility rate did simultaneously increase in the 1980s and decrease in the 1990s.

A positive relationship between female labour market participation and the probability of having a child is found in e.g. Hoem (2000a). She analyses whether the decision to have a first child was influenced by the dramatic changes in the labour market between 1986 and 1997. The results show that first-fertility rates for women rise and fall with employment in different municipalities.

In another paper by Hoem (2000b), where female labour income was used to study differences in the risk for the first child, a strong effect of income on the first child was found. Fertility was lower among those with low or no labour income than among women with high income. It is important to remember, however, that the low probability of a first birth in low-income groups may partly be due to the female students included in this group.

In a paper by Andersson (1999), a number of economic variables and their impact on the probability to give birth at common birth orders in Sweden during the 1980s and 1990s are analyzed. The women were all born in Sweden between 1945 and 1979. The economic information considered in the study was

[2] It is of course possible that the intentions of the spouses not initially are equal and the household's decision is the result from a game theoretical process. However, such aspects of the decision procedure is outside the scope of this paper.

[3] The negative relationship is also well documented empirically, see e.g. Butz and Ward, 1979), Winegarden (1984); Lee and Chuen (1989) and Wang and Famoye (1997).

unemployment benefits, study allowance, pensions, vocational-training program allowance and labour income for the period 1985-1995. The main conclusions were that women with relatively low wages and those in education, exerted lower birth risk than others and that the increase of women in these two groups did cause the falling birth rates during the 1990s. However, the study did not find any effect of unemployment on fertility, which is contradictory to the result in Hoem (2000a). This difference may be due to Andersson's use of individual data, while Hoem uses aggregated data on unemployment. It is reasonable to assume that a high level of unemployment has a discouraging impact on men's and women's plans regarding children, irrespective of whether they are unemployed or not, for example due to a higher degree of insecurity and pessimism.

Following the assumption that good economic conditions may encourage young people to start a family, we would expect the contrary to be discouraging. Gauthier and Hatzius (1997) state that high unemployment in general may also have a discouraging effect on women already in permanent jobs, since the risk of not being re-employed on the same terms as before childbirth or not having the same career opportunities will be too high. A similar result, a strong negative relationship between the local unemployment rate and the probability of a first and second birth, was found on Norwegian data for women aged 20-39 during the period 1989-1995 (Naz, 2000). The effect on fertility from unemployment is, however, not clear cut since women without jobs will also face lower opportunity costs, at least in the short-run.

2.3 Family policy in Sweden

The expansion of the Swedish welfare system is assumed to be one important explanation for the positive correlation between fertility and female labour supply during the 1980s. The effect of family policy on the positive relationship is documented in many studies (see e.g. Sundström and Stafford 1992; Hoem 1996; Björklund, 2005). Reforms concerning children and families have been extensive in Sweden since the 1970s: parental insurance, gradual extension of paid parental leave, speed premium, increased child allowances, extra allowances for families with more than two children, reduced working time for parents of pre-school children and a gradual expansion of day care facilities are important elements of family policy. However, some of these reforms are connected to employment status prior to childbirth, which implies that parents must have had a paid job (eight months or more) to enjoy full benefits. Paid parental leave for example reduces the pecuniary losses when leaving the labour market, which is contrary to the theory suggesting that a woman loses her entire wage income when leaving the labour market. In the case of Sweden, a mother (or father) with a paid job prior to childbirth will enjoy 13 months of paid parental leave and retain 80 percent of their income while on leave. The results in Hoem and Hoem (1996) confirm this, as they found a major impact from social reforms - primarily the expansion of day care facilities and parental leave - on the fertility rate during 1965-1996. The falling fertility rates during the 1990s may similarly be a consequence not only of the economic recession, but also of negative

changes to family policy.

Andersson (1999) for example suggests that the positive relationship depends on the income-replacement character of the parental leave system, which creates strong incentives for women to acquire as high a level of income as possible before having children. Moreover, the norm for young people has long been first education, secondly a secure position in the labour market, and thirdly start a family. Since this norm comprises both men and women, this has also reinforced the idea of sharing responsibility for children. Young women no longer accept the role of sole responsibility for the children and an increasing proportion of young men are reluctant to be the main economic provider. There are primarily two types of costs related to children: direct pecuniary losses when leaving the labour market (for shorter or longer periods), and indirect losses associated with loss of future opportunities. Re-entering on a part-time instead of a full-time basis may also involve a cost if the opportunities in the labour market become more restricted. The general economic situation as well as rules and legislation surrounding female employees are therefore very important in the case of pregnancy. A secure position in the labour market (due to for instance tighter regulations) will lower the cost, while a looser, more insecure and temporary one will raise the costs.

2.4 Human capital

Investment in human capital is a way of improving competitiveness in the labour market. These investments may however make women (and men) postpone the first child (see Gustafsson, Kenjoh and Wetzels, 2001). Depending on a woman's age, postponing may mean fewer children and in some cases no children at all. However, the expected negative effect of higher education on the fertility rate must be treated with caution. Cigno and Ermish (1989) show in a theoretical model that women with relatively greater human capital will have their first child later in life, but this does not necessarily mean that they will have fewer children. They can have as many children as those women who became mothers at a younger age, only the spacing between children is shorter.

2.5 Cost of living and tendency for family building

The normative pressure of having a reasonable standard of living makes the supply of dwellings and their prices an interesting determinant of fertility (see e.g. Andersson 1999). Lack of apartments seems to be a problem mainly in the larger cities, but since there is (and has been for quite a while) a tendency among young people to move into the cities, lack of housing may be a problem. A combination of a younger population in the larger cities and increasing difficulties in finding suitable housing - considering price, size and location - may result in a lower probability of starting a family.

The economic theory of fertility treats the two partners in the household as married in a permanent constellation, see e.g. Becker (1991). From this starting point, analyses concerning the number of births or the timing and

spacing of births are made. Such an approach does not allow study of the impact of changes in preferences for marriage on fertility. We believe that the general tendency in society concerning family formation is important and must be taken into consideration. Number of divorces and number of marriages will be used as crude approximations of the actual trend. The assumption is that a high number of marriages may encourage young men and women to marry and form a family while the opposite may have a discouraging effect. A high number of divorces may exert a negative influence on fertility in the following way: First, if the "survival risk/chance" of female-male relationships is small due to increased divorce rate, there is an evident risk of becoming a lone parent, which may have a discouraging effect on fertility. Secondly, a high divorce risk may stress the importance, for women in particular, of attaining a permanent position in the labour market before becoming a parent in order to avoid the poverty trap. This may at least have a postponing effect on fertility. Thirdly, due to negative experiences of divorces (e.g. as a child, relative or friend), a high divorce rate may result in a reluctance among young people to start a family of their own.

2.6 Summary

The theoretical considerations presented above make the background to the data chosen for the empirical analysis. According to the discussion above we assume that female labour market participation, introduction of family policy reforms and marriages may all have a positive effect on fertility, while cost for living, women enrolled in higher education and divorces are assumed to have a negative effect.

3 Empirical model

Economic models of fertility often focus on the number of children in the household or the timing and spacing of children during the woman's life cycle (see e.g. Tasiran, 1993; Melkersson and Rooth 2000; Westerberg, 2006). Such studies are often based on individual data. In this case we will use aggregate data for a set of macro variables, including fertility rate, for the period 1965-2003.[4]

3.1 Structure of the model

A birth begins with the parents' decision to have a child, thereafter it may take some time to conceive, which is followed by the gestation period. For this reason, we must distinguish between the time when the parents decide to have a child and the time when the birth is actually recorded. When estimating the total fertility rate at time (t), most optimal information is given by a set of covariates (x) that describe the variables that may affect the fertility decision some nine months or so before the time of birth. As an approximation we use the value of the independent variables from the preceding calendar year (see Gauthier and Hatzius 1997 and Poot and Siegers 2001). This means that we will estimate the fertility rate at time period (t) from a set of covariates at time period $(t-1)$.

Slow-moving influences may cause serial correlation of the residuals in time series estimation. Therefore, an autoregressive component will be included in the model. The autoregressive component captures potential sluggish adjustment of fertility to changes in the independent variables (see Gauthius and Hatzius, 1997).

The discussion concerning the long-run effects on fertility from the independent variables can be formalized in the following way:

$$y_t = \alpha + \gamma y_{t-1} + \boldsymbol{\beta}' \mathbf{x}_{t-1} + \varepsilon_t \tag{1}$$

where α, γ and $\boldsymbol{\beta}$ are parameters, y_{t-1} the autoregressive part of the model and ε_t the residual.

However, *changes* in different factors may sometimes be more important for the fertility decision than the actual level of these factors. Gauthius and Hatzius (1997) for example discuss that *changes in unemployment* may be more relevant than the *level of unemployment* for the fertility decision. If the man or the woman, or both, are unemployed and the prospects for tomorrow is still high unemployment then nothing has changed. On the other hand, if one or both of them are employed but the risk of loosing a job increases due to increasing unemployment in general during this or next year, then the probability of having a child may have diminished.

[4] Econometric analysis of fertility in Sweden using the same approach is e.g. Wilkinson, 1973. Their study covers the period 1870-1965 and is based on non-linear autoregressive estimators. The results are interesting since they point out a positive relationship between male wage rate and fertility for the full period but a negative relationship between female wage rate and fertility in the end of the period (1940 -1965)

We believe that the arguments put forward by Gauthius and Hatzius will be true for most variables i.e. not only the rate of unemployment. Therefore, we will also estimate a model which use the differences for all variables including the dependent variable, i.e. TFR between t and $t-1$. Model 2 is used to illustrate in what matter the "change" in fertility can be explained by the "change" in the independent variables.

Considering the short-run effects on fertility from the independent variables equation 2 can be written:

$$\Delta y = \tau + \lambda y_{t-1} + \boldsymbol{\omega}' \Delta \mathbf{x} + \varepsilon_t \tag{2}$$

where Δ is a difference operator, e.g. $\Delta y = y_t - y_{t-1}$ and τ, λ, $\boldsymbol{\omega}$ are parameters

As an alternative to the two models presented above we will also estimate a model where all variables, besides the TFR-variable, are represented both by "level" and by "change".

Equation 3 considers short-run as well as long-run effects on fertility from the independent variables and can be written:

$$y_t = \kappa + \psi y_{t-1} + \boldsymbol{\phi}' \mathbf{x}_{t-1} + \boldsymbol{\eta}' \Delta \mathbf{x} + \varepsilon_t \tag{3}$$

where κ, ψ, $\boldsymbol{\phi}$ and $\boldsymbol{\eta}$ are parameters.

The Ljung-Box Q-statistic is used for testing serial correlation by summarizing the autocorrelations. The Ljung-Box Q-statistic is given by:

$$\Omega = T(T+2) \sum_{j=1}^{p} \frac{r_j^2}{T-j} \tag{4}$$

where r_j is the j-th autocorrelation and T is the number of observations. The Q-statistic can be used to test the hypothesis that all of the autocorrelations are zero; that is, that the series are white noise (see Box and Pierce, 1970).

3.2 Test for structural break

The relationship between the female labour market participation and the TFR was negative until the end of the 1970s, but from the beginning of the 1980s it is positive (see figure 1 above). Several studies such as Sundström and Stafford (1992), Hoem and Hoem (1996) and Björklund (2005) stressed that the change from a negative to a positive relationship between the two variables depends on improvement in the family policy considering support to families with small children.

The changed relationship between the variables during the period, caused by family policy reforms or other reasons, may result in a structural break in the estimation. In that case it will not be possible, a priori, to assume parameter stability during the period 1965-2003. We use the CUSUM-test to test for constancy of regression relationships (see Brown et al., 1975),

$$W_t = \frac{\sum_{k+1}^{r} w_j}{\hat{\sigma}} \tag{5}$$

where $\hat{\sigma}$ is the standard error of the regression fitted to all T sample points. W_t is the cumulative sum of the recursive residuals and will be plotted against t. If there is a structural break in β then W_t will tend to diverge from $E(W_t\ ) = 0$. If the CUSUM-test indicates one (or several) structural break(s), we can split the data into subperiods and compare the mean values of the estimators from the regressions concerning period 1 ($\hat{\boldsymbol{\beta}}_1$) and the subperiods ($\hat{\boldsymbol{\beta}}_i$) respectively, where $i = 2...n$ using the Chow test (see e.g. Greene 1997).

3.3 Data

Data in this study is from official statistics, Statistics Sweden, and cover the period 1965-2003. The dependent variable is the total fertility rate (TFR).[5,6]

The independent variables are sorted into three categories. The first category consists of three variables aimed to measure the economic influence on fertility. The prime interest in the analysis is the female labour force participation rate (*FLP*) and its impact on fertility. We are expecting a positive sign since the positive relationship, between participation and fertility, seems to have surpassed the negative one during the last decades. The second variable has to do with direct costs related to having a family. As a crude measure for "cost of living" we will use an annual index for the rent of a three-bedroom apartment (*rent*). The expected sign is negative i.e. the more expensive it is to rent a flat of decent size, the less probability to start raising a family, or make it bigger. The third variable in this category is women's enrollment in higher education. Our assumption is that women's increasing enrollment in education in general, and on higher levels in particular, may have exerted a negative effect on fertility, temporarily or permanently. We know that postponement of the first birth is common today and one consequence is increasing average age for first-time mothers. In 1980 the average age was 25.5 years, in 1990 26.3 and in 2004 it was 29.0 years. During the period 1965-2003 the number of new female entrants to higher education rose every year, from about 7000 to around 40 000.[7] The variable *(femstudent)* is created by relating the number of newly registered female students to all women in the age of 19 to 30. The sign is expected to

[5] The fertility is measured as total fertility rate (TFR) which is the sum of the age specific fertility rate for women in the ages 16-49 years old. The age specific fertility rate is the number of children borned by women in a specific age related to the total number of women in that age.

[6] TFR is related to women in fertile ages, i.e. non-completed fertility. A measure for completed fertility is the cohort fertility rate (CFR). CFR measures the sum of age specific fertility for a specific cohort older then 49 years old.

[7] Due to the university reform in 1977 the number of registred students did increase dramatically. We have adjusted for this in the estimations.

be negative, i.e. the more women enrolled in higher education, the lower the fertility rate.[8]

The second category considers the family policy. This is however not an easy task to measure, since almost all parts of the family policy was introduced and has been gradually improved, changed or expanded, during this period of time. This makes it almost impossible to statistically isolate the effect of a single program or reform. In order to control for any possible effect we decided to pick child allowance *(chall)* as a representative element of the policy. Child allowance, introduced in 1947, is the oldest ingredient in Swedish family policy. It is still very important although there are questions raised whether wealthier families really are in need for the allowance today. The sign is expected to be positive since the immediate effect should be to lower the "costs" of having children.[9]

The third category consists of variables related to the "private sphere". There are several factors influencing our private lives, but only a few are possible to measure as aggregates suitable for statistical analysis. In this analysis we believe that rate of divorces and rate of marriages may give a crude picture of the private sphere.

The two variables in this category are intended to capture changes related to man and woman as a couple. In 1974 Sweden passed a new legislation simplifying the process of divorce. One immediate effect of that was a substantial increase in the number of divorces, from approximately 15,000 to 25,000 in one year. During the following years the figure stabilized and has been around 20,000 per year from then on.[10] The number of marriages, on the other hand, fell very quickly from 60,000 in 1965 to less than 40 000 in 1973. This number has since then remained rather stable, about 35 000, although there were years in the 1990s with as low as 32 000 marriages.

The dramatic decrease in the number of new marriages at the beginning of the period was however counterbalanced by an almost equal rise in the number of couples cohabiting. This way of living together, without being married, indicates that there are probably a lot of *non-registered* "divorces/marriages" during a year. Since cohabiting is still very frequent, our use of marriages and divorces in the statistical analysis may be of limited value. Being aware of this we will use them anyway. The expected sign for divorces *(divorce)* is, not surprisingly, negative and for marriages *(marriage)* positive. Contrary to men and

[8] An alternative to using the *annual influx* of female students would be the ratio of female students in the age group 19-30 to the total number of women aged 19-30.

[9] We have also tested other family policy variables in the estimations (e.g. the introduction of the parental leave, the extention in the parental leave during the 1980s and the right for parents with small children to work part-time). However, the inclusion of these dummies (separate or in combination with others) give no significant results and are therefore not included in the model.

[10] In 1989 a change in the pension system made it more beneficial (for women) to be married in case of death of the partner. This become a strong incentive to get married among those couples living together without be legally married. The number of new marriages reported for 1989 which deviates strongly from other years have been adjusted.

women just cohabiting we believe that people who decide to marry has made a declaration of intention. An intention where children will be a natural part of their common plans.

The data presented above is illustrated in appendix A.

3.4 Empirical specification of the model

Three different structures are used for estimating the fertility rate for the period 1965-2003. The dependent variable in model 1 is total fertility rate (TFR) at time t and the independent variables are lagged one year $(t-1)$. Model 1 estimates the **long-run effects** on fertility from the independent variables. The specification of model 1 is the following:

$$\begin{aligned} TFR_t = \alpha_0 + \alpha_1 TFR_{t-1} + \alpha_2 FLP_{t-1} + \alpha_3 femstudent_{t-1} + \alpha_4 chall_{t-1} \\ + \alpha_5 rent_{t-1} + \alpha_6 divorce_{t-1} + \alpha_7 marriage_{t-1} + \varepsilon_t \end{aligned} \tag{6}$$

TFR_{t-1} is the autoregressive part of the model; *FLP*, is female labour market participation; *chall*, is the size of the child allowance; *rent* is the annual index of the rent for a three-bedroom apartment; *femstudent* is the relative level of new registered female students every year; *divorce*, is the number of divorces; *marriage*, is the number of marriages. ε_t is the residual, α_0 is the constant and $\alpha_1 - \alpha_7$ are the coefficients.

Contrary to the model above, model 2 estimates the **short-run effects** on fertility from the independent variables. The difference of fertility, ΔTFR, is as the independent variables measured between time t and $(t-1)$. The specification is as follows:

$$\begin{aligned} \Delta TFR = \phi_0 + \phi_1 TFR_{t-1} + \phi_2 \Delta FLP + \phi_3 \Delta femstudent + \phi_4 \Delta chall \\ + \phi_5 \Delta rent + \phi_6 \Delta divorce + \phi_7 \Delta marriage + \varepsilon_t \end{aligned} \tag{7}$$

where Δ is the difference operators equal to e.g. $TFR_t - TFR_{t-1}$, ϕ_0 is the constant and $\phi_1 - \phi_7$ are the coefficients.

Model 3 estimates the **short-run as well as the long-run effects** on fertility from the independent variables. This means that the model will explain fertility from a "level-perspective" as well as from a "difference-perspective" in order to find out if any of the two matters more than the other. Model 3 can be written as:

$$\begin{aligned} TFR_t = \beta_0 + \beta_1 TFR_{t-1} + \beta_2 FLP_{t-1} + \beta_3 femstudent_{t-1} + \beta_4 chall_{t-1} \\ + \beta_5 rent_{t-1} + \beta_6 divorce_{t-1} + \beta_7 marriage_{t-1} + \beta_8 \Delta FLP + \beta_9 \Delta femstudent \\ + \beta_{10} \Delta chall + \beta_{11} \Delta rent + \beta_{12} \Delta divorce + \beta_{13} \Delta marriage + \varepsilon_t \end{aligned} \tag{8}$$

where β_0 is the constant and β_1 - β_{13} are the coefficients.

4 Empirical results

The results of the CUSUM tests are based on equation (5) and presented in Appendix B. According to the test, we cannot reject $E(W_t) = 0$ for any of our three models. Because of the results from the CUSUM tests, we estimate the data in one continuous period for the three models respectively.

The results from the first estimation are presented in table 4.1 below. Ordinary least square (OLS) is used for estimation of model 1.

Table 4.1: Determinants for Swedish TFR. 1965-2003

Dependent variable: TFR_t

Variable	Coeff.	t-values	Coeff.	t-values
TFR_{t-1}	-	-	0.755	6.674
FLP_{t-1}	0.007	2.602	0.008	4.344
Chall_{t-1}	0.008	4.361	0.001	0.892
Rent_{t-1}	0.000	1.670(10)	-0.000	-1.641
Femstudent_{t-1}	-0.132	-5.079	0.019	0.667
Divorce_{t-1}	-0.023	-4.274	-0.013	-3.552
Marriage_{t-1}	0.020	5.962	0.003	0.902
Constant	0.737	2.606	-0.118	-0.530
	adj R^2: 0.841		adj R^2: 0.934	

In the first estimation (column1) all parameter estimates are significant and all signs are as expected. Female labour market participation, child allowance (a crude measure of family policy), rent and marriage will exert a positive effect on fertility while divorces and more women enrolled in higher education decrease fertility. Including the autoregressive variable, TFR_{t-1}, into the model (column 3) does reduce the number of significant parameters to three. Only TFR_{t-1}, the employment rate and divorce parameters are significant. However, the Q-statistics presented in appendix C indicate autocorrelation both with the inclusion and exclusion of the autoregressive component. The results of model 1 must therefore be treated with caution.

In the second model we use difference variables. The dependent variable is $(TFR_t - TFR_{t-1})$ and the independent variables are as in the previous estimation. The results are presented below.

Table 4.2: Determinants for Swedish TFR. 1965-2003

Dependent variable: ΔTFR

Variable	Coeff.	t-values	Coeff.	t-values
TFR_{t-1}	-	-	-0.127	-2.349
Δ_{FLP}	0.004	0.009	0.008	0.862
Δ_{Chall}	0.002	1.551	0.002	1.542
Δ_{Rent}	0.000	0.615	0.001	1.624
$\Delta_{\text{Femstudent}}$	-0.075	-1.548	-0.046	-0.876
Δ_{Divorce}	-0.005	-0.828	0.001	0.119
Δ_{Marriage}	0.014	2.804	0.008	1.608
Constant	-	-	0.199	2.028
	adj R^2: 0.108		adj R^2: 0.239	

In the first estimation (column 1) the coefficient for marriages is positive and significant. The positive effect of changes in the number of marriages is as expected since a marriage (normally) is a formal way of expressing two persons ambition, or intention, to form a family (including children) contrary to couples with just an informal, or a non-existent, contract.

In the second estimation (column 3), with the autoregressive term included one estimate is significant, the positive and significant estimate for TFR_{t-1}. The significant estimate of TFR_{t-1} indicates a persistence in the behavior of fertility. However, the Q-statistics indicate autocorrelation both with inclusion and the exclusion of TFR_{t-1}. The results from this estimation must therefore be treated with caution.

In model 3 both the variables' *level* and *change* are included. In table 4.3 the results are presented.

Table 4.3: Determinants for Swedish TFR. 1965-2003

Dependent variable: TFR_t

Variable	Coeff.	t-values	Coeff.	t-values
TFR_{t-1}	-	-	0.656	3.473
FLP_{t-1}	-0.002	-0.793	0.006	1.809
ΔFLP	-0.013	-0.987	0.007	0.528
Chall_{t-1}	0.009	5.493	0.004	1.754
ΔChall	0.005	2.937	0.003	2.398
Rent_{t-1}	0.000	1.687	-0.000	-0.724
ΔRent	0.003	3.359	-0.000	0.271
Femstudent_{t-1}	-0.121	-5.820	-0.009	-0.254
$\Delta\text{Femstudent}$	-0.181	-2.458	-0.054	-0.758
Divorce_{t-1}	-0.012	-2.131	-0.011	-2.461
$\Delta\text{Divorce}$	0.004	0.581	0.002	0.295
Marriage_{t-1}	0.023	7.114	0.007	1.396
$\Delta\text{Marriage}$	0.012	2.158	0.007	1.398
Constant	0.914	3.190	-0.133	-0.346
	adj R^2: 0.923		adj R^2: 0.946	

In the first estimation (column 1) the coefficients for child allowance, marriages, changes in child allowance, changes in marriages and changes in rent are positive and significant while the share of female students, divorces and changes in the share of female students are negative and significant.

The significant and positive effects of child allowance, marriages, changes in child allowance and changes in marriages are as expected, as are the negative effect from divorces, female students and changes in female students. Whether the last results are short-term effects, caused by postponement, or not is uncertain. The positive and significant coefficient of rent indicates that when the rent level increases the fertility rate increases and vice versa. A somewhat surprising result.

In the second estimation (column 3) the autoregressive term, TFR_{t-1}, female participation, childallowance and changes in child allowance are positive and significant. The parameter estimate for divorces is negative and significant. When the number of divorces goes up the fertility rate goes down and vice versa. The positive effect of female labour market participation supports our assumption but also the results from previous studies on participation and fertility in Sweden. It confirms what we have seen in the descriptive statistics during the last 20-25 years. The interpretation may not be clear cut, but there are reasons to believe that women's labour force attachment no longer is an obstacle for becoming a mother today. Put it another way: If it is hard to find a job in general and for women in particular it should not be any surprise if there also would be a drop in fertility. The insignificant estimate for changes in employment does not disturb this, since we believe it is the level that matters here.

The significant and positive effects of changes in child allowance is as expected. When the child allowance increases the fertilty rate increases. The coefficient of divorces indicates that high number of divorces may have a negative effect in fertility.

The Q-statistics indicate autocorrelation with the autoregressive term excluded, but not with the autoregressive term included.

5 Summary and conclusion

The point of departure of this paper is the strong variation in the Swedish periodical fertility rate (TFR) between 1965 and 2003. Three alternative model structures were used to find reasonable explanations to this. The model including long-run as well as short-run effects seem to give the best results. Female participation rate and child allowances did have a positive and significant effect on fertility while number of divorces had a negative effect. None of these results are of any surprise, rather than the opposite.

The most important result is of course the positive effect of female participation on fertility. The unanswered question is if a high degree of female activity on the labour market has pushed for a social infrastructure adjusted for mothers wanting to work, or if it is the other way around? Our belief is that the existence and the gradual expansion of a social infrastructure enables women (and men) to combine family and work in a reasonable way, may have been an strong driving force. We have not been able to analyze the social infrastructure and the whole range of family policy reforms introduced during the period under study, which may be necessary for the complete scenery. But despite of that we are convinced that the probability of a shift in the relationship between female participation and fertility (from negative to positive) had been small without these reforms. Furthermore, the variations in fertility can be seen as an effect of the actual business cycle. Women's chances to get a job is nowadays probably as much important as it has always been for men.

The CUSUM test does not indicate any structural breaks during the period. This emphasizes that the positive correlation between total fertility rate and female labour market participation has been valid during the entire period 1965-2003. The result deprives to some extent the improvement in the Swedish family policy, during the 1970s and 1980s, as the only cause for the positive correlation between these variables. The positive correlation between the variables can likewise depend on spurious regression caused by omitted variables, such as changes in social norms and changes in gender role for both women and men in the market as well as in the household. Here, much more research is needed.

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Appendix A

Fig. A1: Total fertility rate (TFR)

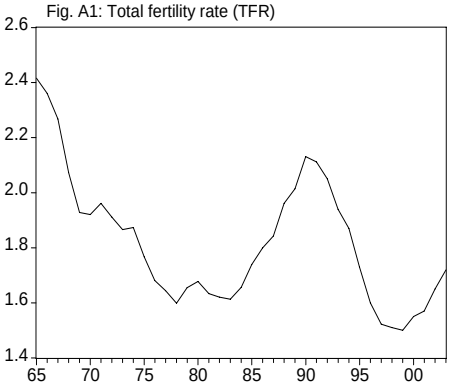


Fig. A2: Female labour market participation (FLP)

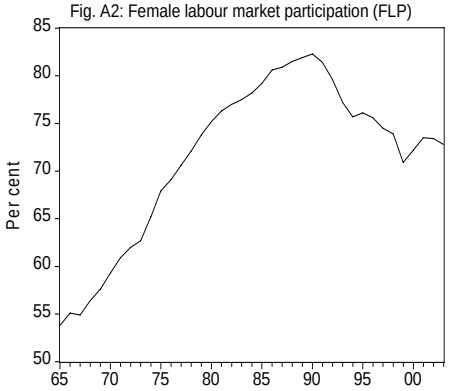


Fig. A3: Annual child allowance per child to constant prices (Chall)

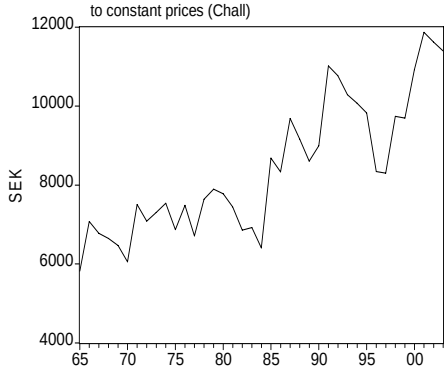


Fig. A4: Rent index (Rent)

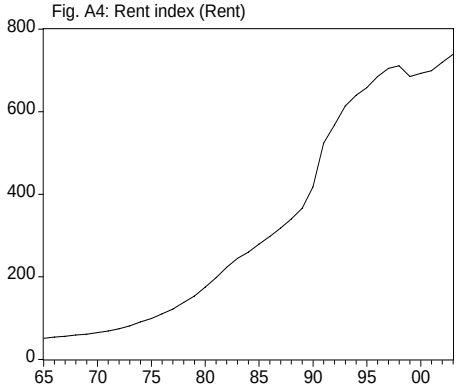
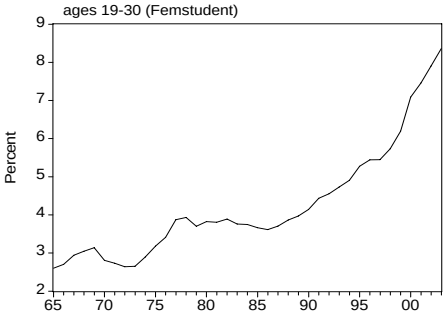
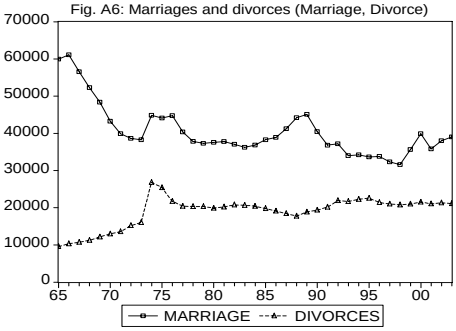


Fig. A5: Relative number of newly registred female students to the number of women in the ages 19-30 (Femstudent)



Data are adjusted to the university reform in 1977

Fig. A6: Marriages and divorces (Marriage, Divorce)



Data considering number of marriages are adjusted for pension system reform in 1989

Appendix B

Fig. B1: CUSUM-test of model 1 with the autoregressive term excluded

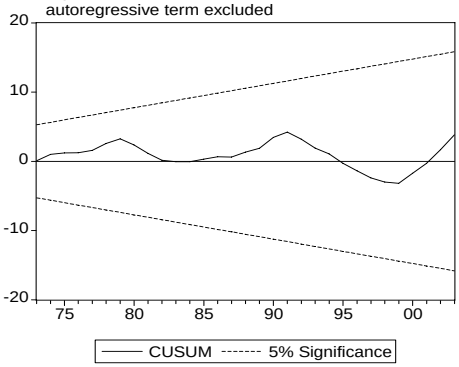


Fig. B1.1: CUSUM-test of model 1 with the autoregressive term included

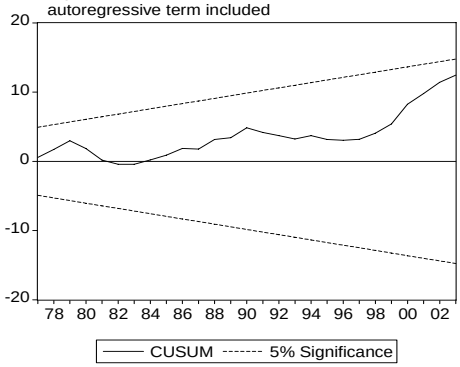


Fig. B2: CUSUM-test of model 2 with the autoregressive term excluded

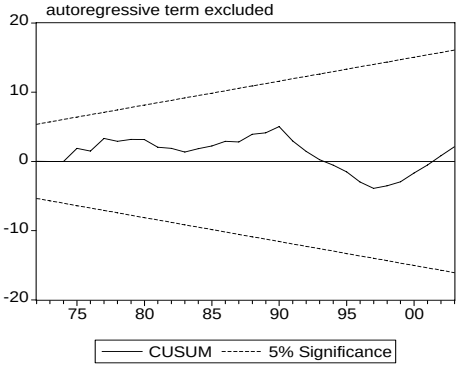


Fig. B2.1: CUSUM-test of model 2 with the autoregressive part included

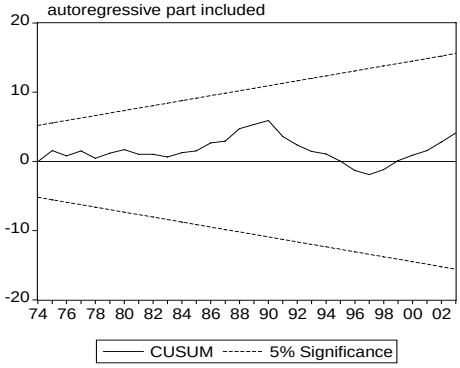


Fig. B3: CUSUM-test of model 3 with the autoregressive term excluded

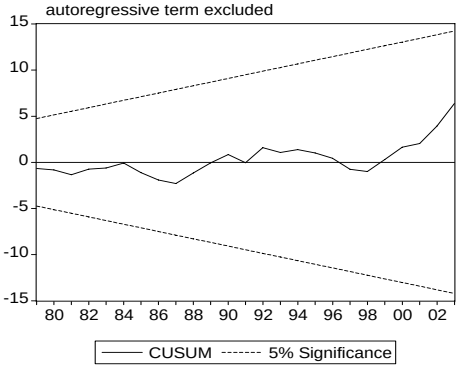
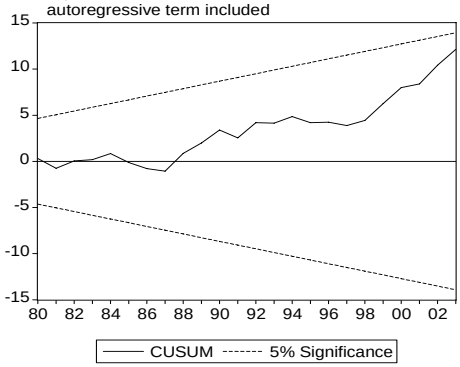


Fig. B3.1: CUSUM-test of model 3 with the autoregressive term included



Appendix C

Model 1

TFR_{t-1} excluded		TFR_{t-1} included	
Q-stat	Prob	Q-stat	Prob
3.99	0.05	4.74	0.03
4.54	0.10	5.25	0.07
7.03	0.08	6.14	0.11
9.05	0.06	6.19	0.19
9.26	0.10	6.30	0.28
10.87	0.09	11.23	0.08
11.74	0.11	24.30	0.00
12.07	0.15	26.05	0.00
12.39	0.19	26.05	0.00
12.40	0.26	26.05	0.00

Model 2

TFR_{t-1} excluded		TFR_{t-1} included	
Q-stat	Prob	Q-stat	Prob
5.46	0.02	6.10	0.01
8.58	0.01	9.22	0.01
8.59	0.04	9.22	0.03
8.87	0.06	9.27	0.06
11.65	0.04	11.55	0.04
13.87	0.03	14.67	0.02
15.40	0.03	21.18	0.04
16.83	0.03	26.90	0.00
17.72	0.04	29.20	0.00
17.74	0.06	30.26	0.00

Model 3

TFR_{t-1} excluded		TFR_{t-1} included	
Q-stat	Prob	Q-stat	Prob
0.488	0.49	0.21	0.65
2.06	0.36	1.37	0.50
9.34	0.03	5.83	0.12
9.35	0.05	6.72	0.15
10.41	0.06	6.73	0.24
10.68	0.10	6.73	0.35
13.29	0.07	10.47	0.16
13.63	0.09	11.23	0.19
14.36	0.11	11.36	0.25
14.84	0.14	11.36	0.33