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## NOTES

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### *A Time Series Study of Fertility in England and Wales, 1877-1938* \*

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The debate over the reasons for the decline in fertility in England and Wales which started in the 1870's and culminated in the 1930's is of long standing and still unresolved.<sup>1</sup> In particular, although many causes of fertility decline have been suggested their relative importance has not been quantified. The use of statistical evidence has been at most descriptive and throughout the post World War 2 period the literature has, in general, denied the possibility of assessing the magnitude of the effects of such putative explanatory factors as falling child mortality, changes in incomes or female employment, improvements in contraceptive technology etc.<sup>2</sup> Moreover the discussion of

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<sup>1</sup> For a summary of the literature and an extensive annotated bibliography, see R. MITCHISON, *British Population Change Since 1860* (1977).

<sup>2</sup> Thus the words of the Royal Commission on Population, "The explanation lies we think in the profound changes that were taking place in the outlook and ways of living of the people... They include the decay of small scale family handicraft and the rise of large scale industry and factory organisation; the loss of security and growth of competitive individualism; the relative decline in agriculture and rise in importance of industry and commerce, and the associated shift of population from rural to urban areas; the growing prestige of science which disturbed traditional religious beliefs; the development of popular education, higher standards of living; the growth of humanitarianism, and the emancipation of women. All these and other changes are closely

fertility change in this period has not been conducted in terms of the economists' models of fertility much used to examine American fertility.<sup>3</sup>

To the extent that the debate has been conceptualised the most important influence is that of Carlsson's distinction between fertility change as an 'innovation' or an 'adjustment' process.<sup>4</sup> The former view stresses the role of the spread of information about contraception, the latter the role of motivation and the structural factors affecting human desires.<sup>5</sup> Subsequent to Carlsson's article much of the debate has been between those siding with 'adjustment' and those believing in 'innovation.'

Shorter, Knodel and Van de Walle (SKW) writing in 1971 placed themselves firmly and self-consciously in the 'innovation' camp.<sup>6</sup> They stressed the parallelism of European declines in legitimate and illegitimate fertility and concluded

If we can safely assume that substantial motivation to avoid non-marital births existed long before the end of the nineteenth century, why then did illegitimate fertility decline at the same time as marital fertility? Under this assumption it appears that either knowledge of or the means to control fertility was much less widespread prior to the marital fertility decline... than is implied by the 'adjustment' model ... an *ad hoc* rummaging about for alternate linkages in an 'economic prosperity' model is unlikely to result in any generalisable kind of explanation.<sup>7</sup>

Thus improved knowledge of contraceptive technology promoted fertility change rather than a greater desire to avert births.

The SKW position is vigorously disagreed with by most other writers on England and Wales. McLaren comes down heavily on the side of 'adjustment':

because means of contraception were available by 1800, the spread of family limitation has to be seen as not so much the result of the diffusion of an innovative technique as an adjustment of the working class family to new economic and

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inter-related... it would be exceedingly difficult to trace how they acted and reacted on each other or to assess their relative importance. We make no attempt here to do so..." *Report Cmnd 7695* (1949), p. 38 are echoed in Mitchison, "It is as well to accept that the motives of human beings, particularly in the most important activity they undertake are not easily to be labelled or measured", loc. cit. 38.

<sup>3</sup> For an introduction to this work see *Journal of Political Economy* LXXXI (1973), Supplement. For an application of economic theories of fertility to historical experience see P.H. LINDERT, *Fertility and Scarcity in America* (Princeton, 1978).

<sup>4</sup> G. GARLSSON, 'The Decline of Fertility: Innovation or Adjustment Process', *Population Studies*, XX (1966), 149-74.

<sup>5</sup> G. GARLSSON, 'The Decline of Fertility: Innovation or Adjustment Process', *Population Studies*, XX (1966), p. 150.

<sup>6</sup> E. SHORTER, J. KNODEL and E. VAN DE WALLE, 'The Decline of Non-Marital Fertility in Europe', *Population Studies* XXV (1971), 375-93.

<sup>7</sup> *Ibid.*, pp. 392-3.

social conditions ... Economic forces in the first period created a demand for child labour that induced workers to adopt a high fertility strategy; the late nineteenth century mature economy rejected the unskilled and uneducated and led to the imposition of fertility control. ... Moreover when the working class began to bring down its birth rate in dramatic fashion it was by relying on traditional, 'pre-industrial' means of fertility control.<sup>8</sup>

The same theme of the very widespread knowledge of birth control methods prior to the fertility decline is emphasised by Habakkuk, who argues for the importance of cyclical depressions in the short term and reduced infant mortality in the longer term as particularly important influences leading to lower fertility.<sup>9</sup>

Silver attempted a crude test of the 'innovation' hypothesis by investigating the sensitivity of marriage to the business cycle and interpreted his finding that there was no significant change over 1856-1958 as evidence against the hypothesis.<sup>10</sup>

Earlier authors had also tended to suppose that changes in the incentive to adopt birth control sprang from social and economic influences on desired family size rather than improved contraception. Glass argued in terms of cultural changes,<sup>11</sup> Banks in terms of threats to the relative status of the upper-middle classes<sup>12</sup> and Innes also advocated a class norms approach.<sup>13</sup>

The main thrust of the literature has then been to regard fertility decline as an 'adjustment' phenomenon. Most writers, whilst accepting there were improvements in knowledge and availability of birth control methods, have thought these were of only minor significance and the McLaren view would apparently say of no significance. There is, however, no agreement on what the key stimuli to adjustment were. SKW strongly dispute the 'adjustment' approach and find improvements in contraceptive technology and information the key change.

The debate has a wider importance in that policy implications relating to economic development in Third World Countries are being drawn from historical studies. Knodel and Van de Walle have suggested that the historical evidence can be interpreted to indicate that an improved availability of

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<sup>8</sup> A. McLAREN, *Birth Control in Nineteenth-Century England* (1978), pp. 13-4.

<sup>9</sup> H.J. HABAKKUK, *Population Growth and Economic Development since 1750* (Leicester, 1972), pp. 66-7.

<sup>10</sup> M. SILVER, 'Births, Marriages and Income Fluctuations in the United Kingdom and Japan', *Economic Development and Cultural Change XIV* (1966), 302-15. Silver argued that if methods of birth control improved one would expect to see less postponement of marriage in recessions.

<sup>11</sup> D.V. GLASS, *Population Policies and Movements in Europe*, 2nd Edition (1976), pp. 24-82.

<sup>12</sup> J.A. BANKS, *Prosperity and Parenthood* (1954).

<sup>13</sup> J.W. INNES, *Class Fertility Trends in England and Wales, 1876-1934* (Princeton 1938).

birth control methods is sufficient to bring about fertility decline without requiring any particular threshold of economic development before their adoption.<sup>14</sup> Others writers tend to argue the need for prior 'development' for fertility decline although without necessarily agreeing as to what facets of 'development' are required. For example, Wrigley suggests:<sup>15</sup>

The key change was from a system of control through social institution and custom to one in which the private choice of individual couples played a major part in governing the fertility rate<sup>16</sup> ... Perhaps in seeking an explanation for the comparative simultaneity of fertility change across much of Europe in the later nineteenth century, one should have more regard to the independent importance of falls in mortality in creating a situation in which change could occur and less to measures of economic modernity<sup>17</sup>.

Lindert has recently stressed the possible importance of changes in relative child costs as a key determinant of declines in fertility during economic development, together with relative income changes<sup>18</sup> and he found evidence to support these arguments for the United States.<sup>19</sup> Whilst Lindert accepts the possible significance of the improved availability of contraception,<sup>20</sup> he is rather sceptical about the importance of child mortality reductions.<sup>21</sup>

The aim of this paper is to provide both an explicit model and quantitative testing of some hypotheses mentioned above. In section I an economic model of fertility is related to the historical literature, in section II empirical results are obtained from the model and in section III some of the wider historiographic and policy implications of the results are briefly considered. Finally in section IV there is a summary and tentative conclusions are drawn.

## I

Prima facie the history of birth control can be interpreted either from an 'innovation' or an 'adjustment' standpoint. An 'innovationist' could cite many improvements in contraceptive technology during the nineteenth and early twentieth centuries together with an increasing wave of propaganda about birth control.<sup>22</sup> In addition, use could be made of survey results such

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<sup>14</sup> J. KNODEL and E. VAN de WALLE, 'Lessons from the Past: Policy Implications of Historical Fertility Studies', *Population and Development Review* V (1979), 217-245.

<sup>15</sup> E.A. WRIGLEY, 'Fertility Strategy for the Individual and the Group', in C. TILLY (ed.), *Historical Studies of Changing Fertility* (Princeton 1978), 135-154.

<sup>16</sup> *Ibid.*, p. 148.

<sup>17</sup> *Ibid.*, p. 152.

<sup>18</sup> P.H. LINDERT, 'Child Costs and Economic Development', in R.A. EASTERLIN (ed.), *Population and Economic Change in Developing Countries* (Chicago, 1980), p. 16.

<sup>19</sup> P.H. LINDERT, *loc. cit.*, fn. 3.

<sup>20</sup> P.H. LINDERT, *loc. cit.*, fn. 18, p. 16.

<sup>21</sup> *Ibid.*, p. 49.

<sup>22</sup> See, for example, the discussion in GLASS, *op. cit.*, pp. 24-56.

as those of Lewis-Faning reported in Table 1 which indicate an increasing proportion of birth controllers, an increasing proportion of users of appliance methods and a decreasing proportion citing ignorance as a reason for non-use during the first half of the twentieth century.

TABLE 1  
RESULTS OF THE LEWIS-FANING BIRTH CONTROL SURVEY

Date of marriage	% Using Appliance	% Using Non-Appliance	% Non-Users	% Non-Users 'ignorant'
pre 1910	2	13	85	30
1910-9	9	31	60	17
1920-4	18	40	42	12
1925-9	22	39	39	7
1930-4	30	33	37	12
1935-9	37	29	34	6

Source: E. LEWIS-FANING, *Report on an Enquiry into Family Limitation and its influence on Human Fertility during the past 50 years*. (1949), p. 8, 175.

Note: The sample used was not a fully random sample.

An advocate of adjustment, on the other hand, can point to substantial evidence of use of birth control in the eighteenth century,<sup>23</sup> the apparent reliance on coitus interruptus as the modal technique in the nineteenth and early twentieth centuries and the existence of very substantial variations in fertility in confined geographic areas in the early years of the decline which are illustrated in Table 2.

The economist's approach to fertility does not regard the decline of the birth rate as to be explained in terms either of changes in desired family size or of the spread of contraceptive technology. Rather it would see the availability of birth control characterised in terms of the cost of contraception as one of the determinants of desired family size along with, say, income, the female wage rate etc. Thus economic models of fertility rather than postulating a dichotomy between 'adjustment' and 'innovation' would propose a synthesis. Unfortunately, this complicates the process of inference from the historical evidence. Once it is recognised that contraceptive strategies are costly, the existence of some information on and the use of birth control in the eighteenth century does not per se preclude the possibility of falls in the cost of information and use of various forms of birth control<sup>24</sup> from increasing its adoption and reducing fertility. Similarly, contraceptive techniques

<sup>23</sup> McLAREN, *op. cit.*, pp. 19-36.

<sup>24</sup> Including, of course, cases of new contraceptives whose price was previously infinite.

TABLE 2

## LEGITIMATE FERTILITY IN URBAN LANCASHIRE IN 1881

Registration District	Legitimate Births/1000 married women 15-45 <sup>1</sup>
Liverpool <sup>2</sup>	277
Prescot	330
Ormskirk	298
Wigan	338
Warrington	324
Leigh	314
Bolton	291
Bury	267
Barton-u-Irwell	280
Manchester <sup>2</sup>	273
Salford	288
Ashton under Lyne	271
Oldham	262
Rochdale	237
Haslingden	269
Burnley	290
Blackburn	289
Preston	298

Source: Registrar General's Reports for 1880, 1881, 1882 (P.P. 1881 xxvii, 1882 xix, 1883 xxx) and the 1881 Census (P.P. 1883, lxxx).

## Notes:

<sup>1</sup> An average of legitimate births in 1880, 1881 and 1882.

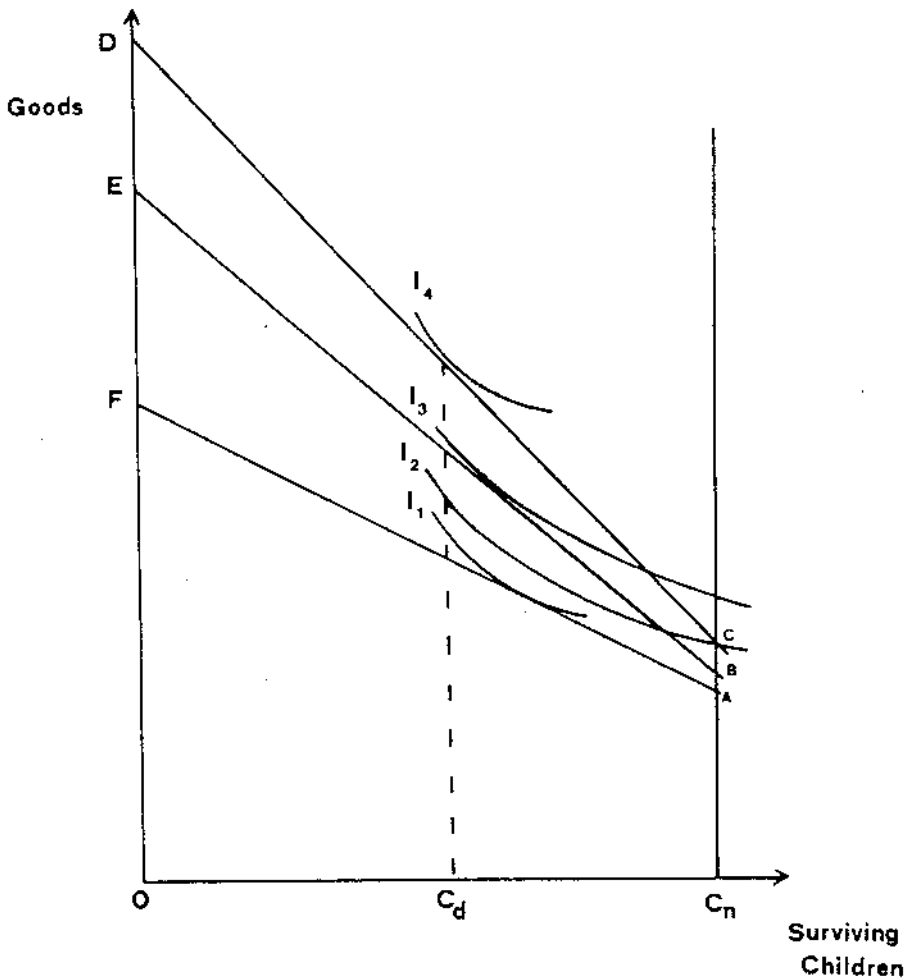
<sup>2</sup> 'Liverpool' is made up of Liverpool, Toxteth Park and West Derby registration districts and 'Manchester' comprises Chorlton, Manchester and Prestwich registration districts.

offer differing combinations of fixed and variable costs and the optimal technique will vary depending on the number of births it is desired to avert so that the increasing use of appliance methods may reflect falls in desired family size from, say, rising female wage rates rather than improved contraceptive knowledge.<sup>25</sup>

The role of changing contraceptive costs in an economic model of fertility can be illustrated by a diagram (Fig. 1) developed by Easterlin. The framework is of a household maximising utility subject to a budget constraint, a time constraint and a technology constraint relating the production of final consumption goods including children to inputs of time and commodities.

<sup>25</sup> This argument is developed fully in R.T. MICHAEL and R.J. WILLIS, 'Contraception and Fertility: Household Production under Uncertainty', in N.B.E.R., *Household Production and Consumption* (New York, 1976), pp. 27-93. Appliance methods would have higher fixed information costs and would be more likely to be chosen if it were desired to avert many births.

The line CD represents the rate at which the household can trade off a commodity against children surviving to adulthood in a world of costless contraception. Its slope depends amongst other things on the costs of supporting children and, in a case where child care is done by wives, the female wage rate. Ideal family size  $C_d$  is that chosen if contraception is free.  $C_n$  is maximum effective fertility, depending for an individual couple on infant mortality and fecundity — it shifts to the right if infant mortality rates fall. Costly contraception initially is reflected in the budget line AF — fixed costs are the distance AC and variable costs are reflected in the slope of AF being less steep than that of CD. A superior contraceptive technology is represented



Note: Adapted from R. EASTERLIN, 'The Economics and Sociology of Fertility: A Synthesis', in C. TILLY (ed.), *Historical Studies of Changing Fertility* (Princeton, 1978), p. 93.

by the budget line BE drawn for a case where the new technology has both lower fixed and variable costs. The situation illustrated is one where an improvement in contraceptive technology would cause this household to adopt birth control and reduce fertility to achieve  $I_3$  compared with a previous position where non-adopting allowed a higher indifference curve,  $I_2$ , than adoption  $I_1$ .<sup>26</sup>

The diagram could also be used to indicate other cases where adoption of birth control could be triggered.<sup>27</sup> For example, a fall in infant mortality could push  $C_n$  far enough to the right to push the household to a level of welfare below  $I_1$ , if they fail to adopt birth control. Or a rise in the female wage rate could cause a pivoting of the budget line AF sufficient to allow an indifference curve higher than  $I_2$  with adoption.

A more formal treatment,<sup>28</sup> simplified to regard children as of constant quality including mortality, would see the household undergoing a constrained optimisation procedure, maximising the Lagrangean

$$U(C, G) + \lambda(\pi_c C + \pi_g G - I) \quad (1)$$

where  $\pi_c C + \pi_g G = (F_c W_f + M_c W_m + p x_c) C + (F_g W_f + M_g W_m + p X_g) G =$

$$W_f T_f + W_m T_m + V = I \quad (2)$$

The first order conditions imply

$$\frac{\delta u / \delta c}{\delta u / \delta G} = \frac{\pi_c}{\pi_g} \quad (3)$$

where  $U$  is utility,  $C$  is children,  $G$  is goods,  $\pi_c$  is the shadow price of children  $\pi_g$  the shadow price of goods,  $I$  is full income,  $F$  is wife's time,  $M$  is husband's time,  $x_c$  is market goods input into a unit of  $C$ ,  $X_g$  is market goods input into  $G$ ,  $p$  is the price of market goods,  $T_f$  is time of the wife in the labour market,  $T_m$  is the time of the husband in the labour market and  $V$  is nonlabour income. A conventional preference map and well behaved production functions will generate a normally sloped compensated demand curve for children.

Higher contraceptive costs can be thought of as lowering  $\pi_c/\pi_g$  and reducing  $I$ . Lower child mortality reduces the costs of a surviving child but lowers

<sup>26</sup> Note this argument is built on choice not uninformed ignorance.

<sup>27</sup> Note in each case a necessary but not sufficient condition is  $C_n > C_a$ .

<sup>28</sup> For fuller treatments see T.P. SCHULTZ, 'Determinants of Fertility: a Micro-economic Model of Choice', in A.J. COALE (ed.), *Economic Factors in Population Growth* (1976), pp. 89-124 and R.J. WILLIS, 'A New Approach to the Economic Theory of Fertility Behaviour', *Journal of Political Economy* LXXXI (1973, S 14 - S 64).

the number of births required to obtain a survivor. A priori, the effect on fertility is uncertain but the latter effect is normally supposed to dominate.<sup>29</sup>

Whilst changes in non labour income have only income effects on the demand for children (positive for normal goods), changes in wage rates have income and possibly substitution effects. To the extent that parents' time is used more intensively in child care than market work an increase in the parental wage rate tends to raise the shadow price of children relatively. It is generally assumed that the wife's time is intensively used in child care and that the effect of a rise in the female wage rate will tend to lower the demand for children (the substitution effect dominating) whereas a rising male wage rate is generally expected to raise the demand for children.<sup>30</sup>

Lindert has ingeniously suggested how proportionate changes in relative child cost  $\pi_c/\pi_G$  may be measured as  $\Sigma(\Delta P_i/P_i) \times (c_i - d_i)$ , the sum of proportionate changes in input prices weighted by their relative intensity of use in child production and in the extra activities that would have been enjoyed in the absence of another child.<sup>31</sup> Using data for the United States he finds that the most important inputs with differing intensities of use are especially mother's time and food which are relatively intensive and manufactured goods which are relatively non-intensive in child production.<sup>32</sup>

A demand curve for births of the following kind <sup>33</sup> is implied for households with negligible nonlabour income

$$B = f(W_m, W_f, \text{Child mortality, price of manufactures, price of food, contraceptive cost}) \quad (4)$$

with the signs on  $W_m$ , manufactured goods' prices, contraceptive cost and probably child mortality positive and the others negative.

The framework of equation (4) requires a little further elaboration. In particular, the demand for children should depend on tastes. Obviously, in considering individual couples this is crucial. In the aggregate the distribution

<sup>29</sup> SCHULTZ, *op. cit.*, p. 100, 122.

<sup>30</sup> FOLLOWING SCHULTZ, *op. cit.*, pp. 112-3, define  $S_{MC} = \frac{M_c W_{FG}}{C \pi_c}$  and defining  $S_{FC}$ ,

$S_{MG}$ ,  $S_{FG}$  analogously then the full price elasticities are  $\eta_c W_m = \eta_c \pi_c (S_{MC} - S_{MG}) + \frac{T_m W_m}{I} \eta_c I$  (where  $\eta_c I$  is the income elasticity of demand for children and the first

term on the right hand side is the compensated price elasticity) and  $\eta_c W_f = \eta_c \pi_c$

$(S_{FC} - S_{FG}) + \frac{T_f W_f}{I} \eta_c I$  For plausible values the argument in the text holds.

<sup>31</sup> P.H. LINDERT, *loc. cit.*, fn. 3, p. 95.

<sup>32</sup> *Ibid.*, p. 374.

<sup>33</sup> Theoretically a distinction may be drawn between quantity and quality of children. This has to be ignored for data reasons and child quality is thus part of the composite commodity.

of tastes in time series demand studies is generally assumed constant or approximated by a trend. In the case of fertility, however, Easterlin and his colleagues have argued that tastes for children are positively related to relative income, i.e. by the ratio of the current standard of living to an expected standard and Lindert found this to be important in cross section analyses of early twentieth century United States data.<sup>34</sup>

Also fecundity affects the ability of households to achieve a given target family size. This too, although bothersome at the micro level, has generally been taken as constant in aggregate studies. The question of the feasibility of ex ante fertility plans does, however, raise important difficulties with the economic theory of fertility. Family formation is a sequential process and it remains an open question whether the static lifetime utility maximisation process outlined above is wholly adequate to examine fertility choice. Nonetheless, as Lindert argues, the uncertainty of conception under birth control or non-control does imply that both 'planned' and 'unplanned' births emerge as a result of a chosen contraceptive strategy.<sup>35</sup> Also, it would be an extreme view that supposed that contraceptive strategies were chosen without regard to child benefits and costs. Moreover, under at least some contraceptive strategies aggregate actual fertility will exceed planned fertility by an amount depending additively on the contraceptive failure rate<sup>36</sup> and this is assumed to be the case in the empirical work of the next section.

In order to proceed along these lines it is necessary to develop a proxy for the contraceptive failure rate as a measure of contraceptive cost. Two obvious possibilities arise; one would be to use literacy and the other, following SKW, would be to use the illegitimacy rate. In fact, for our period it makes no difference which is adopted for estimation purposes and the two variables are very highly correlated.<sup>37</sup> Adding illegitimacy to equation (4) in place of contraceptive cost offers the chance to test SKW's maintained hypothesis that the increasing availability of contraception reflected in lower illegitimacy was the crucial variable accounting for reductions in legitimate fertility during our period. Equation (4) thus becomes

<sup>34</sup> P.H. LINDERT, *loc. cit.*, fn. 3, pp. 162-3.

<sup>35</sup> LINDERT, *loc. cit.*, fn. 3, pp. 61-66.

<sup>36</sup> See the simulation results in N.F.R. CRAFTS and N.J. IRELAND, 'Family Limitation and the English Demographic Revolution: A Simulation Approach', *Journal of Economic History* XXXVI (1976), 613. A rather similar approach, although with a different functional form, is used by M.L. WACHTER, 'A Time Series Fertility Equation: The Potential for a Baby Boom in the 1980's', *International Economic Review* XVI (1975), 609-624.

<sup>37</sup> In the regressions reported in section II substituting the proportion of females at  $t - 11$  who signed the marriage register with a mark for ILLEG did not alter the results materially. This measure of illiteracy has a correlation coefficient of 0.98 with illegitimacy for our period.

$B = f(W_m, W_r, \text{Child mortality, price of manufactures, price of food, relative income, illegitimacy})$  (5)  
with the sign on relative income positive.

Equation (5) can be linked to the historiography reviewed in the introduction. For example, the thesis of Habakkuk could be stated as an emphasis on  $W_m$ , Child mortality and relative income with the signs as in (5) and presumably with large elasticities, together with a view that illegitimacy would have a small and possibly insignificant coefficient. SKW, on the other hand, would expect illegitimacy to have a positive coefficient with a large value and other variables to be insignificant or at least to have little impact on  $B$ . Lindert would presumably accept this formulation but with scepticism about the sign on infant mortality. In principle the framework could be extended to include additional tastes variables, related to class for example, in order to accommodate other aspects of the literature (e.g., Innes's hypotheses) but such hypotheses are better investigated in cross-section studies and are not dealt with in the following section.

Much has been made of the point that contraception is costly in the preceding exposition. It should be noted that appliance methods were indeed very costly in the late nineteenth century, even abstracting from information costs. Knight cites 3/- per dozen as the usual price for sheaths in the 1880's<sup>38</sup> and comments that 'Successful female contraception required time, space, perseverance, and above all money. The minimum outlay was 5/- to 6/- for which one could buy a cheap syringe, a dozen soluble pessaries and a box of quinine powder.'<sup>39</sup>

The formulation of the model in this section also helps to modify the historical literature on female employment and fertility. It has been noted that in the late nineteenth century a tendency existed for areas of high female employment to experience relatively low fertility<sup>40</sup> but since married women's participation rates were low and not rising during our period<sup>41</sup> female employment as an opportunity cost reason for declining fertility has tended to be discarded.<sup>42</sup> The argument of this section suggests that it is premature to discount female earnings as a possible reason for fertility decline since the appropriate variable to consider is the female wage rate. Certainly this will have

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<sup>38</sup> P. KNIGHT, 'Women and Abortion in Victorian and Edwardian England', *History Workshop* IV (1977), 57-69.

<sup>39</sup> *Ibid.*, p. 59.

<sup>40</sup> E.M. ELDERTON, *Report on the English Birthrate, Part I, England, North of the Humber* (1914).

<sup>41</sup> D. BAINES, 'The Labour Supply 1860-1914', in R.C. FLOUD and D.N. McCLOSKEY (Eds.), *A New Economic History of England since 1700* (Cambridge, 1981).

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a bigger impact in times of high female participation but low participation rates do not necessarily mean no impact, *ceteris paribus*.

## II

For estimation purposes the model was specified in linear form and as a partial adjustment equation for annual data. A dummy variable was used to allow for the effects of World War I. As has been the general practice in this area estimation was by single equation methods. Estimation using lagged dependent variables may involve autocorrelation not detected by the Durbin-Watson statistic and preferred estimates were obtained using the Cochrane-Orcutt iterative technique. Results for this are reported in Table 3. Data sources are reported in the notes of that table.

Several of the data series require comment, however. Child mortality is measured as the sum of deaths per 1000 persons living at ages 0-5, 5-10, 10-15. The important point to note is that the theory of section I works in terms of children surviving to adulthood which makes child mortality the correct variable to use rather than infant mortality.<sup>43</sup> In the case of nineteenth century England and Wales this matters since infant mortality declines much later than child mortality, which falls in the 1870's and 1880's whereas infant mortality is roughly constant until the turn of the century.

Relative income is measured in a fashion close to the spirit of Easterlin and similar to the approach of Wachter.<sup>44</sup> It is the ratio of current per capita income to the average of that prevailing in the period 10 years to 14 years ago. It must be acknowledged that this is an arbitrary measure and it is open to others to suggest and estimate alternatives for this non-observable. As the series derived may be of more general interest it is reproduced in full in the appendix.

There are also data problems associated with the series for female wage rates. Time series wage data for females are sparse prior to World War II. Available sources do permit the construction of a series, although not an ideal one, and it is also tabulated in the appendix.

It is important to use as dependent variable a series for marital fertility which controls for age structure, although changes in this were not large.

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<sup>43</sup> This point is correctly emphasised by P.C. MATTHIESSEN and J.C. McCANN, 'The Role of Mortality in the European Fertility Transition: Aggregate Level Relations', in S.H. PRESTON (ed.), *The Effects of Infant and Child Mortality on Fertility* (1978), pp. 47-68. Since one would normally expect a lag in the impact of child mortality on fertility, child mortality was lagged 11 years in the regression of Table 3. Using child mortality lagged only one year does not affect other coefficients in the regression but produces a lower point estimate of the coefficient, 0.019 and the t statistic falls to 0.868.

<sup>44</sup> WACHTER, *loc. cit.*, pp. 613-4.

TABLE 3

A TIME SERIES MARITAL FERTILITY EQUATION FOR 1877-1938

(Dependent variable is $LBR_t$ 1)		(t statistics in parentheses)	
Constant	78.713 (2.311)	Short Run Elasticities	Long Run Elasticities
$W_{m,t-1}$ 2	-0.870 (-1.086)	-0.11	-0.19
$W_{f,t-1}$ 3	-0.327 (-7.805)	-0.24	-0.42
$CHM_{t-1}$ 4	0.032 (1.521)	0.08	0.14
$MANF_{t-1}$ 5	0.274 (3.289)	0.19	0.34
$FOOD_{t-1}$ 6	-0.138 (-1.654)	-0.10	-0.17
$RELY_{t-1}$ 7	39.371 (3.872)	0.22	0.39
$ILLEG_{t-1}$ 8	2.673 (2.869)	0.12	0.21
DUMMY 9	-34.175 (-7.133)		
$LBR_{t-1}$	0.433 (5.522)		
$\bar{R}^2$	0.992		
DW	1.988		
$\rho$	0.016		

Notes.

1  $LBR_t$  is legitimate births per 1000 married women aged 15-45 in England and Wales from Registrar General 76 th Report (P.P. 1914/16, IX) and Registrar General's Statistical Review for England and Wales 1941 (H.M.S.O. 1945).

2 Per capita income from employment from C.H. FEINSTEIN, *National Income, Expenditure and Output of the United Kingdom, 1855-1965* (Cambridge, 1972), pp. T4-5 deflated by Feinstein's price index p. T140.

3 For 1877-1900 an average of industrial wages of women from the appendix by G.H. WOOD in B.L. HUTCHINS and A. HARRISON, *A History of Factory Legislation* (1903) and female post office clerks in G. ROUTH, 'Civil Service Pay 1875-1950', *Economica* XXI (1954), p. 216 and servants wages in W.T. LAYTON, 'Changes in the Wages of Domestic Servants during Fifty Years', *Journal of the Royal Statistical Society* LXXI (1908), p. 523. For 1901-8 an average of the domestic servants and post office wages and for 1908-14 post office wages alone. For 1914-1938 an average of minimum wages for women established by trade boards and reported in A.L. BOWLEY, *Prices and Wages in the United Kingdom, 1914-20* (Oxford, 1921) and in A.L. BOWLEY, 'Wages, Earnings and Hours of Work, 1914-1947, United Kingdom', *London and Cambridge Economic Service Special Memorandum* no. 50.

4 Sum of deaths/1000 persons living at ages 0-4, 5-9, 10-14 from Registrar General, *loc. cit.*, footnotes 1.

5 For 1877-1899 the price index of manufactured consumer goods in J.B. JEFFERYS and D. WALTERS, 'National Income and Expenditure of the United Kingdom, 1870-1952', in S. KUZNETS

(ed.), *Income and Wealth*, Series V (1955), p. 39. For 1900-1938, the price index for durable household goods in FEINSTEIN, *loc. cit.*, fn. b, pp. T134-5.

<sup>6</sup> For 1877-1899 the price index is that of wholesale prices for food generated by the Board of Trade and reported in B.R. MITCHELL and P. DEANE, *Abstract of British Historical Statistics* (Cambridge, 1962), p. 476. For 1900-1938 based on Feinstein's food price index, *loc. cit.*, fn. b, pp. T134-5.

<sup>7</sup> Relative income is derived using the series for  $W_m$  and measuring the value for time  $t$  divided by the average for the five years ending in  $t - 10$ .

<sup>8</sup> Illegitimate births/1000 unmarried women aged 15-45 from Registrar General *loc. cit.*, fn. a.

<sup>9</sup> The dummy variable takes the value 1 for 1915-1919 and 0 elsewhere.

<sup>10</sup> Calculated for mean values of the dependent and independent variables.

The dependent variable is therefore defined as legitimate births/1000 married women aged 15-45. It is not possible to obtain more precise standardised marital fertility rates on an annual basis.

The regression suggests that the opportunity cost of children and relative incomes did matter in the explanation of fertility decline during 1877-1938 as is proposed by the economic approach to fertility. The position of SKW that improvement in contraceptive knowledge and technology are all that matter is firmly rejected by the regression.

On the other hand, the coefficient on ILLEG is positive and significant and could be interpreted along SKW lines to indicate that reduced contraceptive costs lowered fertility as predicted by the economic theory. Table 4 would suggest that improved knowledge could account *ceteris paribus* for about one half of the pre-1895 decline in fertility and about 15 per cent of the post-1895 decline.<sup>45</sup> Virtually identical results are obtained using illiteracy instead of ILLEG in the regression.

TABLE 4  
SOURCES OF DECLINING MARITAL FERTILITY

	Actual Change Since 1877	Change in ILLEG	Change in CHM	Change in $W_t$	Change in FOOD & MANF	Change in RELY	Change in $W_m$
1895	- 46.6	- 22.2	- 7.4	- 6.3	- 4.6	+ 5.6	- 12.6
1913	- 106.0	- 31.1	- 14.7	- 18.5	- 1.7	- 20.8	- 16.0
1938	- 190.2	- 43.4	- 32.0	- 102.7	+ 32.1	- 2.1	- 40.1

Source: Derived from Table 3.

Interpretation of the ILLEG coefficient in this way requires further comment, however. In general there are many reasons for changing levels of illegitimacy and ILLEG may not be a good measure of the effects of changes

<sup>45</sup> Thus the findings of SILVER, *loc. cit.*, fn. 10, p. 315 are not supported.

in contraceptive costs. There are, however, reasons to believe that the SKW interpretation of ILLEG is plausible. The recent literature on non-marital sex does not suggest that the period was characterised by declining levels of non-marital sexual intercourse<sup>46</sup> and the proportion of pre-marital conceptions in England and Wales in 1938 was nearly as high as in 1970.<sup>47</sup> Moreover, Laslett has stressed that the pattern of regional stability in illegitimacy rankings persisted during the decline in illegitimacy whereas an economic explanation of changing illegitimacy would not predict this.<sup>48</sup>

An examination of changes in illegitimacy at the registration district level strengthens this last point. Table 5 presents results of regressions concerning the year when illegitimate and legitimate fertility levels had declined by 10 per cent from pre-decline levels, a variable used by Knodel,<sup>49</sup> in large registration districts which were urban.<sup>50</sup> The results show that whilst the onset of legitimate fertility decline was significantly related both to economic variables and sociological variables proposed in the literature, illegitimate fertility decline was apparently independent of socio-economic factors.

A doubt remains about the SKW type interpretation of ILLEG about which nothing can be done. There are suggestions in the literature that abortion was a particularly common occurrence when single women became pregnant.<sup>51</sup> This creates two possible difficulties: first, changes in abortion technology and costs may not have matched improvements in other forms of contraception and secondly, there is no way of knowing how the perceived possibility of criminal proceedings affected the incidence of abortion and illegitimacy over time.

If one is prepared to accept the SKW view that changes in illegitimacy are a good proxy for the effects of improvements in contraceptive technology and knowledge, and for our period that is certainly possible, then there is a significant impact on marital fertility. The full SKW position cannot be accepted, however. The costs of children have a more important effect on marital fertility than contraceptive knowledge. Moreover, in Table 5 variables which would feature strongly in an 'adjustment' explanation of fertility change

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<sup>46</sup> See, for example, the discussions in E. SHORTER, *The Making of the Modern Family* (1976) and P. LASLETT, *Family Life and Illicit Love in Earlier Generations* (1977).

<sup>47</sup> S.F. HARTLEY, *Illegitimacy* (1975), p. 190.

<sup>48</sup> P. LASLETT, 'Introduction', in P. LASLETT, K. OOSTERVEEN and R.M. SMITH (eds.), *Bastardy and its Comparative History* (1980), especially pp. 29-38.

<sup>49</sup> The analysis of German fertility decline by Knodel is largely in terms of these variables, see J. KNODEL, *The Decline of Fertility in Germany, 1871-1939* (Princeton, 1974).

<sup>50</sup> The districts were selected on the basis of having at least 5000 married women aged 15-45 in 1871 and comprising at least 80 per cent urban districts, county or metropolitan boroughs.

<sup>51</sup> See, for example, R. SAUER, 'Infanticide and Abortion in Nineteenth Century Britain', *Population Studies* XXXII (1978), p. 91.

DECLINES IN LEGITIMATE AND ILLEGITIMATE FERTILITY  
IN REGISTRATION DISTRICTS: REGRESSION RESULTS

Dependent Variable	DECLBR <sup>1</sup> -10	DECIBR <sup>2</sup>
Constant	2318.501 (5.321)	1286.379 (2.012)
WPR <sup>3</sup>	-0.972 (-2.142)	-1.137 (-1.336)
INFM <sup>4</sup>	3.081 (1.481)	
RVPOP <sup>5</sup>	0.809 (1.489)	1.599 (1.586)
NMPOP <sup>6</sup>	-0.112 (-2.277)	-0.104 (-1.109)
ILL <sup>7</sup>	1.005 (2.079)	-0.568 (-0.640)
MIN <sup>8</sup>	0.118 (2.393)	0.011 (0.117)
TEXT <sup>9</sup>	-0.446 (-6.325)	-0.127 (-0.971)
$\bar{R}$ <sup>2</sup>	0.638	0.060
N	87	87

## Notes:

<sup>1</sup> DECLBR is the year in which legitimate births/1000 married women aged 15-45 fell by 10 per cent from its 1871 value; population figures were interpolated between censuses and fertility data taken from various reports of the Registrar General.

<sup>2</sup> DECIBR is the year in which illegitimate births/1000 non married women aged 15-45 fell by 10 per cent from its 1861 value; population figures were interpolated between censuses and fertility data taken from various reports of the Registrar General.

<sup>3</sup> WPR is the female labour force participation rate in 1871 taken from the *Census* (P.P. 1873 LXXII).

<sup>4</sup> INFM is the average infant mortality rate in 1861-70, *Registrar General Supplement to the 35th Report* (P.P. 1875 XVIII).

<sup>5</sup> RVPOP is rateable value of property in 1871 per person. Derived from the *Census and Local Taxation Returns* (P.P. 1886 LVI).

<sup>6</sup> NMPOP is net immigration derived by subtracting natural increase from actual increase and dividing by 1871 population using the *Census* (P.P. 1872 LXVI).

<sup>7</sup> ILL is the proportion of women signing the marriage register by mark, a widely accepted measure of illiteracy, *Registrar General 34th Report* (P.P. 1873 XX).

<sup>8</sup> MIN is the proportion of male workers employed as miners in 1911, *Census* (P.P. 1913 LXXXVIII).

<sup>9</sup> TEXT is the proportion of male workers employed in textiles in 1911, *Census* (P.P. 1913 LXXXVII).

<sup>10</sup> A regression of DECLBR against DECIBR gives the following:

$$\text{DECLBR} = 27.622 + 0.191 \text{ DECIBR} \quad R^2 = 0.049 \\ (2.103)$$

account for a large part of the variance in dates of decline of legitimate fertility by district and although the proxy for contraceptive knowledge (ILL) is statistically significant it explains only a small part of the variance. Indeed, Table 5 is consistent with the arguments of Innes on class norms and Elderton on the role of female employment in fertility decline.

For the purposes of investigating the effects of economic variables on legitimate fertility it is obviously desirable to control for illegitimacy rather than risk bias in the estimated coefficients by omitting it from the regression. Thus, even if one is sceptical of the SKW justification for illegitimacy appearing in the regression and, for example, would prefer to regard it a tastes variable, nevertheless in examining the economic theory of fertility decline the estimates obtained with ILLEG included are superior.

The results of Tables 3 and 4 do not support the view that declining child mortality was a major source of falling legitimate fertility. The coefficient on child mortality in Table 3 is insignificant and small enough that Table 4 shows only a minor effect of reduced child mortality, especially in the nineteenth century. The estimated elasticities are very similar to those found in cross-section studies of post World War II low income countries which range from 0.05 to 0.28.<sup>52</sup>

If child costs variables are omitted from the regression, then the coefficient on child mortality trebles in size and becomes highly significant. The resulting elasticities are virtually identical to those found by Wilkinson for Sweden 1870-1910<sup>53</sup> in a regression similar to that of Table 3 with the child cost variables omitted. It would seem quite possible that time series studies of historical fertility change run a serious risk of substantial upwards bias in the estimated effects of changes in infant mortality if they fail to control for child costs.

The results of Tables 3 and 4 do not support Habakkuk's child mortality explanation of fertility decline and are much closer to Lindert's a priori expectations. The results are also very much in line with Lindert's position as far as child costs are concerned. Tables 3 and 4 are highly supportive of the economic theory of fertility. Each of the child costs variables has the predicted sign and two are highly significant. Table 4 indicates a strong effect of child costs on legitimate fertility for the twentieth century part of the period. Glass was probably deceived by a misspecification (using employment rates rather than wage rates) into discarding the female labour participation opportunity cost explanation for part of the fertility decline which Elderton had advocated.

The elasticity of marital fertility with respect to female wage rates is close

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<sup>52</sup> SCHULTZ, *loc. cit.*, fn. 28, p. 122.

<sup>53</sup> M. WILKINSON, 'An Econometric Analysis of Fertility in Sweden, 1870-1965', *Econometrica* XLI (1973), pp. 633-642.

to the range cited by Schultz for post World War II low income countries of  $-0.16$  to  $-0.35$ . Also the relative magnitude of the coefficients on  $W_r$ , MANF and FOOD matches the evidence produced by Lindert on relative child costs quite well.<sup>54</sup> The apparent suitability of a household choice approach to the adoption of birth control does not support a point of view that historical evidence indicates the irrelevance of developmental factors to fertility decline.<sup>55</sup>

The coefficient on relative income is also significant and of the predicted sign, again matching the findings of Lindert for the United States. Table 4 highlights the different consequences of the behaviour of relative income, raising fertility prior to 1895 and lowering it noticeably during 1895 to 1913, as relative income fell from a value of 1.41 in 1895 to 1.03 in 1913 in the well-known period of real wage stagnation. This supports Habakkuk's basic view on relative income but drastically changes the periodisation. In fact, the *ceteris paribus* effect of rising relative income seems to have raised fertility somewhat during the so-called Great Depression of 1873-1896 and only thereafter to have lowered fertility, at least for the economy in the aggregate.

The coefficient on  $W_m$  is negative and insignificant, although the point estimate gives an appreciable elasticity. Whilst this does not confirm Habakkuk's hypothesis of a positive and significant coefficient, it is not particularly surprising. The income elasticity of demand for births as opposed to the quality of children may well be low or negative and Schultz reports a range of values for a men's wage elasticity of demand for births of 0.05 in low income and  $-0.11$  to  $+0.23$  in high income countries.<sup>56</sup> This result is probably not very damaging to an economic theory of fertility change.

Thus on this evidence child costs are seen as the main impetus to fertility decline taking the period 1877 to 1938 as a whole. Changes in contraceptive knowledge, child mortality and incomes played more minor supporting roles. Whilst the simple SKW hypothesis that only better contraceptive knowledge mattered is refuted, the economic theory of fertility is not.

### III

The results of section II are interesting in a wider historiographic context. The combination of coefficients on relative income and income, if they applied also to the earlier period, are potentially consistent with Lee's finding that social control of population size and the level of living was very weak<sup>57</sup>

<sup>54</sup> P.H. LINDERT, *loc. cit.*, fn. 3, p. 374.

<sup>55</sup> Cf. KNODEL and VAN DE WALLE, *loc. cit.*, fn. 14.

<sup>56</sup> SCHULTZ, *loc. cit.*, fn. 28, p. 122.

<sup>57</sup> R.D. LEE, 'Population in Pre-industrial England: An Econometric Analysis', *Quarterly Journal of Economics* LXXXVII (1973), p. 605.

for pre-industrial England since they would imply that this potential force for homeostatic adjustment was weak.

The results also suggest a conjecture for future research, namely that the reason for fertility falls being delayed well beyond the classic industrial revolution period in Britain is related to a failure of the relative costs of children to rise and perhaps also that in some way Britain differed from France (whose fertility fall was much earlier) in this regard. Certainly the apparent success of the choice framework suggests that restrictions on childwork imposed after the industrial revolution but before our period could have had an important effect on fertility as McLaren argues.<sup>58</sup>

Finally it is worth noting the fairly low elasticity of fertility with respect to ILLEG in Table 3. Whilst there is nothing in these results to say that improved availability of birth control would not be sufficient to achieve fertility declines in developing countries, the low elasticity does not encourage the view that family planning programmes would bring about very rapid reductions of fertility in the absence of other changes such as rising child costs.

#### IV

The results of this paper indicate that it is possible to make a tentative, quantitative assessment of the factors leading to marital fertility decline in England and Wales from the 1870's. The main arguments made in the paper are as follows.

1) The economist's choice model of fertility is a useful approach to the study of fertility change in England and Wales during the classic fertility decline. The model avoids a dichotomy between 'adjustment' and 'innovation' and integrates lower contraceptive costs into the decision making process about the adoption of birth control.

2) The proposition that improved contraceptive knowledge alone was responsible for declining fertility is decisively rejected.

3) Nevertheless improved contraceptive knowledge may well have played a part in the process of fertility decline, albeit probably a relatively minor one.

4) Rising relative child costs were an importance cause of declining fertility and Easterlin's relative income hypothesis is also supported.

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<sup>58</sup> MCLAREN, *loc. cit.*, fn. 8, p. 14.

## APPENDIX

	Index Numbers of Women's Wage Rates	Relative Income		Index Numbers of Women's Wage Rates Nominal	Relative Income
1875	82	1.36	1907	103	1.09
1876	82	1.32	1908	114	1.04
1877	83	1.29	1909	114	1.01
1878	83	1.29	1910	114	1.00
1879	83	1.27	1911	114	1.02
1880	85	1.22	1912	114	1.02
1881	89	1.26	1913	114	1.03
1882	89	1.30	1914	114	1.12
1883	89	1.25	1915	118	1.20
1884	89	1.23	1916	119	1.24
1885	90	1.22	1917	132	1.30
1886	88	1.18	1918	172	1.39
1887	88	1.23	1919	193	1.34
1888	88	1.28	1920	301	1.27
1889	88	1.38	1921	262	1.17
1890	89	1.43	1922	239	1.23
1891	91	1.41	1923	238	1.22
1892	93	1.35	1924	242	1.21
1893	93	1.34	1925	252	1.17
1894	93	1.40	1926	249	1.12
1895	95	1.41	1927	252	1.17
1896	95	1.41	1928	249	1.11
1897	98	1.36	1929	249	1.10
1898	98	1.33	1930	249	1.10
1899	98	1.34	1931	249	1.13
1900	100	1.27	1932	248	1.14
1901	100	1.23	1933	248	1.22
1902	100	1.17	1934	248	1.28
1903	100	1.15	1935	248	1.30
1904	100	1.08	1936	252	1.31
1905	103	1.08	1937	260	1.29
1906	103	1.08	1938	265	1.28

Sources: See text Table 3.