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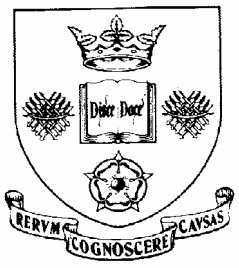

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Occupational Mortality, Age at Marriage and Marital Fertility
Early Twentieth Century England and Wales

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Introduction

What factors determine fertility and to what extent do we really understand the decision processes that underpinned when to marry, when to start having children and how many children to have in the historical past? In many ways, the posing of such questions may seem surprising given the now copious literature on the subject.[1] In this paper we use new datasets built from previously under-exploited primary source materials and improved econometric modelling to build on previous work and thereby improve on our understanding of the determinants of the demand for children in early twentieth century England and Wales.

Standard economic theory tells us that the fertility is best explained in terms of the demand for children (Leibenstein, 1957; Becker, 1981, 1988). From this assumption, the Chicago-Columbian school (Mincer, 1963; Nerlove, 1974) explained fertility in terms of the demand for children. This approach adopted a production function approach to explain the demand for children in terms of socio-economic development, namely increases in the relative price of children. Children, it is argued, require inputs of time and goods, and the price of children depends on the prices of these inputs. Price is related to the wife's time in childbearing and rearing and as such, changes in the demand for children are related to increases in the opportunity costs of the wife's time. In contrast, the Pennsylvanian school (Sanderson, 1976, 1980; Behrman and Wolfe, 1984) has drawn our attention to supply side issues, namely the supply, cost and understanding of contraception and desired family size. This approach stresses that the demand for children is not for births *per se* but *for surviving* children. As such, the supply side school emphasises the influence of infant mortality rates on fertility. There is now a consensus in the literature based on substantive

empirical research, that whilst supply side issues have dominated in pre-modern societies, demand then assumed importance as households shifted to a potential excess supply of children and the opportunity costs of women's time became important.

Whilst standard economic models may explain the determinants of fertility behaviour in pre- and post-modern societies, they do tend to ignore the issue of nuptiality. There is an implicit assumption in the economics literature that age of marriage was a factor in pre- but not postmodern societies. Yet there is a large historical literature relating fertility to the nuptiality decisions, with the latter being rooted in prevailing contemporary socio-economic conditions. From Malthus (1803) to Wrigley and Schofield (1981), the argument is that in pre-modern societies, men and women determined the decision on when to marry according to prevailing economic conditions. More recently, Szreter and Garrett (2000) have related nuptiality to class by finding evidence of a novel pattern of highly prudential, late marriage among the bourgeoisie in the course of the eighteenth and early nineteenth centuries. They also find evidence of an increased trend towards 'prudential' marriage throughout the population after 1816. Nuptiality, in other words, is back on the research agenda.

What of conditions in early twentieth century England? How can we understand fertility behaviour amongst couples in a period when modernisation had indeed occurred, but when infant and child mortality (by modern standards) were still high, when women's opportunities for earned income were limited, when 'modern' methods of contraception (i.e. 'the pill') were not available, when household incomes

were (in the main) determined by the earnings of the husband, prior to a welfare state which might provide support in times of economic distress (be it unemployment, pensions or health at the point of need)?

To date, much of the literature has attempted to explain the lagged timing of the transition[2] to low fertility rates to economic change. The notion that fertility behaviour varied according to social class in the early twentieth century was noted by an official at the Office of the Registrar General who supervised the analysis of the 1911 Census (Stevenson, 1920) and later became the subject of an investigation by Innes (1938). Subsequent analysis has spawned a large and scholarly literature. Social class (Banks, 1981; Haines, 1989; Woods and Smith, 1989) and/or urbanisation (Boyer and Williamson, 1989; Teitelbaum, 1984; Szreter and Hardy, 2000) have been used to 'proxy' improvements in the standard of living that may prompt the switch to low fertility regimes. All claim to find an important link between the income (or wealth) proxied by occupational/social status or urbanisation of households and their propensity to control fertility. What is *missing* from such albeit valuable work, we would argue, is any sense that families may have based their decisions on marriage and fertility on their anticipated life earnings: namely the number of years they could reasonably expect the husband to work – and thereby earn income.

To date, econometric modelling on the determinants of patterns of fertility in the early twentieth century has been constrained by data availability in terms of *explanatory* variables. Data on the dependent variable – namely births per women by age and duration of marriage – are, however available.[3] The early twentieth century has provided scholars with an important dataset with which to examine fertility behaviour – namely the 1911 Fertility Census, which tabulates recorded fertility by

age at marriage, duration of marriage and occupational status of husband. That Census has prompted significant contributions to the literature, notably by Crafts (1989), Haines (1989) and Szreter, (1996) who have demonstrated that opportunities for female work, infant mortality, social status and the wealth of households largely determined fertility behaviour.[4] A common, if understandable problem, in such models has been the propensity to develop aggregate models that may disguise, we would argue, differences in cause and effect mechanisms between different occupational groups. Equally, the need to use 'all embracing' proxies for explanatory variables has clouded our understanding of how and why different economic and social factors may influence the fertility decision.

Why then should we revisit the 1911 Census and the explanations for recorded fertility in England and Wales? The motivation for this paper is threefold: first in Section 1, we present our findings for new datasets, which build on prior work to improve on the explanatory variables determining fertility at this period of time. Second, in Section II, we consider our dependent variables and derive a theoretical model, which encompasses both the nuptiality and fertility decisions – arguing that the timing of marriage and the number of children to have were joint decisions. Appendices 1 and 3 detail the source materials, variable definitions and data included in our model. Third, (in Section III), we present our findings of what really determined both the timing of marriage and the number of children had according to occupational status and presents our findings. Section IV concludes.

I

In this paper we argue that the decision on when to marry and how many children to have at the turn of the century in England and Wales was a *joint* decision. Those decisions we argue were in turn a function of desired family size (defined as desired surviving children), predicted number of years of male (husband) household income and the opportunity costs of women's time (female earnings). In this section we explain our choice and estimation of explanatory variables (see Appendix 1 for data sources and estimations).

The Pennsylvanian school has made it clear that explanatory models should be couched not in terms of the demand for children *per se*, but for *surviving* children. At the turn of the century, and despite decreasing trends in child mortality from the childhood diseases of inter alia, measles, diphtheria and scarlet fever, parents still lost children to these diseases.[5] As such, the desired number of surviving children would be influenced not only by prevailing infant but also by childhood mortality levels. We argue that childhood mortality should be explicitly included in any model as an explanatory variable. To that extent, and given the fact that the 1911 Census includes observations on childhood mortality, by occupational group, age at and duration of marriage it is surprising that this has not been incorporated into prior studies. We have therefore (drawing on the returns of the 1911 census) explicitly included child mortality (that is children who died as a percentage of those born) to each occupational group by duration of marriage and age at marriage of the wife as one of our explanatory variables.

Our estimates reveal significant variations between occupational groups in terms of infant and child mortality – and hence an on-going human tragedy experienced by couples in given occupations in early twentieth century England and Wales faced with the certain 'knowledge' that any child born stood a high chance of dying (See Appendix 2). That knowledge was experienced to an acute degree amongst married couples where the husband was employed as a shipyard labourer, a seaman, in iron manufacture, as a skilled and unskilled worker in iron foundries or as a dock and wharf labourer. Child mortality amongst these groups was the highest recorded amongst all couples married for all marriage durations in 1911.[6] By contrast, couples where the man was employed as an accountant, architect, civil engineer, author or journalist, banker, clergy, solicitor, or gamekeeper (standard professional middle class occupations) were spared (relatively) from the anguish of child mortality.[7] Prima facie the empirical evidence suggests marked contrasts at the turn of the century between the professional and manual occupational groups in terms of the effects of child mortality on surviving children and hence fertility: thus the need to include explicitly child mortality as an explanatory variable in any model of the demand for children.

Child mortality, we argue, was an important explanatory variable determining fertility amongst couples (defined in terms of the occupation of the husband) in early twentieth century England and Wales – but so was infant mortality. Couples of all marriage durations recording the lowest levels of infant mortality were ones where the husband was employed as a civil servant, banker, architect, author and journalist, doctor, solicitor, civil engineer, clergy, shopkeeper and naval officer.[8] By contrast, infant mortality was highest amongst couples where the husband was employed as an

unskilled foundry worker, a cutler, a shipyard labourer, an earthenware manufacturer, a dock or wharf labourer, and a worker in steel manufacture.[9] What of changes over marriage durations? Our cross sectional data make it difficult to determine with any precision the implications of changes in infant and child mortality over time. What our data do show, however, is that infant mortality was highest amongst couples of all occupations married between 15 and 20 years in 1911 [10] and was highest amongst couples where the husband worked as an unskilled foundry worker, a shipyard labourer, a dock or wharf labourer, and a worker in steel manufacture or as a costermonger/pedlar.[11] Crafts (1989) has already shown that in a cross section model over regions in 1911 that infant mortality had an important effect on the demand for children; we would argue that it had an important effect on the decision processes of couples where the husband worked in different occupations.

Household income, and wealth, were determined not only by both the earned annual income of the male head of household but also by the number of years the male head of household might be expected to live and earn a livelihood. To this extent we have built new datasets that estimate both earnings and the number of years of anticipated earnings – as separate variables. To date, male income has not been included as an explanatory variable in work on the determinants of fertility at the turn of the century – a surprising, but understandable, omission given data availability problems. We argue, however, that the decision of couples on when to marry (age of marriage) and how many children to have would be determined in part by the anticipated earned income of the husband. Given the importance we attach to this calculation by couples at the turn of the century, a new dataset was created which assigned earned weekly wage estimates to different male occupations. Our estimates

of male wage rates were derived from both primary and secondary sources,[12] expressed in 1906 shillings per week (BOT Earnings and Hours Report, 1906) per year.[13]

Our findings (Table 1) are suggestive of a very wide variation in male earnings: sufficient to explain why some couples, desirous of a given number of surviving children, would have reason to marry and have children at an early age. Not surprisingly, couples where the husband was employed in a professional middle class occupation were in receipt of the highest weekly and annual incomes. Some couples were in receipt of in excess of over 100s a week (£5) – namely solicitors, doctors, barristers, dentists, chemists, authors and journalists and army officers. At the opposite end of the income spectrum, families where the male earner was employed as a scavenger or dust collector, a dyer in textiles or a paviour received less than 23s a week (£1.15); those of a road labourer or porters less than 22s a week (£1.1); those of a porter less than 21s a week (£1.05), whilst those of a platelayer less than 21s, that of a factory labourer and shepherd less than 20s a week. At the very bottom of the earned income hierarchy are the families where the male was employed as a horse-keeper or groom managed on 19s a week (£0.95) and those of an agricultural labourer 17.5 shillings (£0.88) a week.

Table 1 about here

A noticeable (and crucial) omission from both the above theoretical and empirical work is explicit and quantified acknowledgement and inclusion of income over the life cycle income. Life cycle income, we argue, is a function of how long

one expects to be in paid employment, which, in turn, is function of prevailing levels of illness (morbidity) and of age of death (mortality). At the time, workers, local doctors and many in the higher echelons of the medical profession were well aware of the health risks associated with given occupations. The risks of losing the male bread-earner through a variety of occupational hazards does not however appear to have figured in work on the fertility decision (Arlidge, 1892; Ogle, 1885; Oliver, 1902; Thackrah, 1832; Thatham, 1897). In recent years, the literature on occupational health has tabulated occupational morbidity and mortality in relation to given industries and occupations at the turn of the century (Rosen; Tweedale, 2001). To date, this growing literature has drawn our attention to the morbidity and mortality implications of, inter alia, working in coalmines and the textile industry (Bowden and Tweedale, 2002 and 2003; Johnston and McIvor, 2000). Belated attention to the relationship between the determinants of the demand for children and occupational health risks amongst couples is, we would argue, an important omission from the literature to date and one which we seek to rectify.

Contemporaries were sufficiently concerned that the Registrar General, on a decennial basis, was required to tabulate mortality by occupation. That information includes data on the age distribution of deaths within given occupations. We have therefore explicitly included variables that quantify the extent to which early mortality was 'the norm' in different occupational groups. We argue that the decision on when to marry and when to have children was a function of how long couples believed the male head of household would live. Anticipated early death would prompt early marriage – and children – whilst longevity would encourage a later age at marriage and the postponement of child bearing. In these terms a couple marrying in a coal-

mining district would marry early and have children early – whilst a 'clerical' couple would be under no such pressure to marry and start child bearing at an early age.

Examination of the returns revealed significant variation between occupations in the age of death (Table 2 and see Appendix 2).[14] In 'extreme' cases (that is the differences between the longest and the shortest lived male occupations) the differences were in excess of twenty years. Given our argument that the risks of early death would encourage couples to marry early and to have children early in their marriage, the explanatory variable used to proxy the 'death risk' is the percentage of deaths in given occupations accounted for by deaths under the age of 35. In late nineteenth century England and Wales, the probability of dying before the age of 35 was extremely low amongst clergymen, coal-merchants, farmers, inn-keepers in agricultural districts, wheelwrights, and maltsters.[15] In contrast, there was a one in four risk of dying before the male worker reached the age of 35 if the man worked in glass manufacture, bookbinding, tin and tin plating, coal mining or in the Lancashire cotton mills.[16] The most hazardous occupations however were coal mining in South Wales, printing, railway driving, hairdressing and zinc working.[17] Again, we would argue that a couple desirous of a given number of surviving children would have good cause, dependent on the husband's occupation, to marry early – whilst in other occupations the absence of any such risk afforded the luxury of the choice to postpone marriage until a later age. The health risk was such to have had a significant effect on the timing of nuptiality and of fertility.

Table 2 about here

The opportunity costs of women's time has figured prominently and been found to be statistically significant in econometric explanations of the demand for children. To date, this consideration (Crafts, 1989) has been modelled in terms of the labour force participation of *single* women. Yet secondary sources have contended with conviction that the demand for children was heavily influenced by the opportunity for work amongst married women (Hewitt, 1958; Roberts, 1982). We would argue that the decision to marry and to have children was determined not only by the availability of work for *married* women, but also by the wage they might receive. In essence, the timing of both nuptiality and fertility was a function of the income loss to the wife of giving up work.

To date, testing of such a hypothesis has been precluded by data availability. Given the importance we attach to this explanatory factor, we estimated new datasets that quantified waged income of married women according to marital status and the occupation of husbands using a random sample of enumerators' returns from the 1901 Census. Previous work on fertility was, of course, constrained by lack of access to the enumerators' returns for this Census given the 100 Year Rule. The release of the documents in the recent past has allowed us to examine female working patterns that previous scholars have been unable to**.** The returns have enabled us to sample primary materials, which detail the occupational status of married women: that is evidence on the opportunity costs of fertility for the wives of occupied married men. The enumerators' returns were used to provide an estimate of the occupations of married women; these were then linked to a range of primary and secondary sources to derive earned income of given 'female' occupations and hence the opportunity costs of married women's time.[18]

Our approach is novel in terms of a methodological approach involving a simultaneous equation model that explores a) first the decision to marry and b) second the decision to have children. We have approached the demand for children as a system of two equations. We first estimate the demand for marriage. This is based on the proposition that if husband has a relatively short expected working life, the more it is likely that couples will marry young. We then estimate the demand for children. To some extent, our claim that couples faced a joint decision: to marry and have children at an early age, is not a new one. Friedlander, (1973) Haines (1977) and Schellekens et al (1985) all noted the propensity of coal miners to marry early and to have children at an early age.[19] We would argue, however, that this observation is not limited to that of couples in coal mining communities. What is new is that we seek to build this observation into an econometric model that tests for joint decisions over *all* occupational groups in early twentieth century England and Wales. We argue that occupational mortality was a factor that influenced the joint decision of when to marry and have children of all occupational groups at the turn of the century. In the following section we build on this observation and the above discussion on our explanatory variables to discuss the elaboration of our explanatory model.

II

We argue that the age at marriage and the number of children per couple (births per woman) in early twentieth century England and Wales were *jointly determined* based on the expected male wage and lifetime earnings, the female wage rate (her opportunity cost), expected child mortality (anticipated child survival) and the expected mortality of the male partner. We note that despite the absence of 'reliable'

contraception, couples did practice birth control, that birth control was practiced by couples from all social classes (Seecombe, 1990) and that parity-specific control was common. In this paper, whilst acknowledging that couples may indeed have made conscious decisions to terminate childbearing at a given age (Watkins, 1986; Woods, 1987) and have 'spaced' their children (Crafts, 1989; Roberts, 1982 and 1988), we observe that the timing of marriage remained an important determinant of fertility

In essence, we argue that persons in occupations in which men were more likely to die young, leaving widows with small children, would have *more of* an incentive to marry at young ages than persons in occupations where men were more likely to live past age 55 or 60. Higher child mortality, we argue, would require more births per couple to reach the same level of children who survive to adulthood. Occupations with earlier ages at death were likely to wish to have more children survive to adulthood as insurance against disability and impoverished widows/mothers than would other occupations. As a result, we expect to find that occupations in which there is higher male mortality would have lower ages at marriage, and higher births per woman than will occupations in which the male is more likely to die at older ages. In addition, we would expect that occupations with high child mortality would have both lower ages at marriage and higher numbers of births per woman. The effect of wage rates in this period, however, may be ambiguous since higher wages allowed couples to afford more children (of any given level of quality), as well as more of all other goods, or fewer children of higher quality (more expensive inputs) or fewer children and more of other assets to insure income in old age or disability.

The dependent variables are a) the age of marriage of women by duration of marriage and occupation of the husband and b) the number of children by duration of marriage and occupation of the husband derived from the 1911 Census of Fertility. Appendix 2 details occupations where the age of marriage and the number of children were the lowest and highest.

There are, however, inherent sources of bias in the data from the Fertility Census of 1911. First, the data refer only to intact couples and, as such, omit widows. Second, the data refer only to current marriages and, as such ignore the families of prior marriages, that is those where one spouse has died young and the other has remarried – the children of the original marriage are not included in the Census returns because they are not defined as the offspring of the *current* marriage. Third, the returns ignore the extent of remarriage. This, we find, was particularly common amongst older brides, which leads to an upward bias on the mean age at marriage. The 1901 Census for Sheffield, for example, revealed a great deal of remarriages – dependents listed as 'step-son/daughter'; listed as 'son' but too old to be a child of the 'wife of head'; many women, with children, listed as 'living on own means'. Given that the occupational categories do not have the same number of couples (since the values of the variables are the averages for the occupation), the data are expected to be heteroskedastic.

We argue in this paper that the age at marriage and the number of children per couple (births per woman) were *jointly determined* based on the expected male wage and lifetime earnings, the female wage rate (her opportunity cost), expected child mortality and the expected mortality of the male partner. We therefore estimated a

model[20] based on a system of two equations, one for age at marriage, and one for births per woman, in which:

$$\text{age at marriage} = \beta_{10} + \beta_{11}\,\text{births per woman} + \beta_{12}\,\text{child mortality} + \beta_{13}\,\text{female wage rate} + \beta_{14}\,\text{probability male dies before age 35} + \varepsilon_1$$

$$\text{births per woman} = \beta_{20} + \beta_{21}\,\text{age at marriage} + \beta_{22}\,\text{child mortality} + \beta_{23}\,\text{male wage rate} + \beta_{24}\,\text{male wage squared} + \beta_{25}\,\text{probability male dies before age 35} + \varepsilon_2$$

Appendix 3 details the variables included in the explanatory model. The model was estimated using a generalized method of moments estimator with White's heteroskedasticity consistent covariance matrix. The squares of both male and female wage rates were included as instruments due to the skewness in both endogenous variables. Including the square of the male wage in the fertility equation allows increases in the male wage to have a different response for high wage and low wage occupations. The square of the female wage rate was not significant in the age at marriage equation and was eliminated from the model. The female wage is included in the age of marriage equation as it is the best estimate of the foregone costs to a woman of marrying and having children. The male wage is included in the fertility equation as children are considered an asset to the couple and the level of asset holdings are best described a function of the family wealth, i.e. the male wage. As this is a system of simultaneous equations, both variables cannot be entered in both equations as it would be impossible to identify the coefficients of the equations in that case (Pindyke and Rubinfeld, 1998).

III

What then determined the joint decision of when to marry and how many children to have amongst occupational groups in early twentieth century England and Wales? First examining the demand for marriage and for fertility amongst marriage durations of all durations (that is, of 0 to 25 years (Table 3)), it is apparent that we are correct to argue that the decision was a joint decision. We find that age at marriage and the number of births per woman is indeed jointly determined. A Hausman test for endogeneity rejects the hypothesis that both age at marriage and births per woman are exogenous at a significance level of $p < 0.001$. High child mortality and the probability that a man will die early act to lower the age at which women would choose to marry. Occupations with high probabilities of dying young, marry earlier than those with a lower likelihood of dying young, and that higher expected child mortality encourages earlier marriage. Both the high probabilities of dying young and high levels of child mortality lower the number of births per woman, probably due to the fact that the Fertility Census of 1911 only includes data on current, intact marriages, actual rather than desired fertility. Women may plan to accomplish the desired level of fertility by allowing for more than one marriage, due to high levels of male mortality, therefore marrying at an earlier age to allow for the interruption of child-bearing due to their husbands' mortality.

Table 3 about here

Beginning with nuptiality, our model can explain 77% of the variation in age at marriage across occupations, which is high for a cross-section model. All variables are significant at better than five per cent significance level and have the predicted signs. A five percent increase (just over 1 standard deviation) in child mortality leads

to a 0.6 year decrease in the average age at marriage independent of any other influences. A ten per cent increase (slightly more than one standard deviation) in the probability that the male will die before reaching age 35 leads to a 0.3 year decrease in the age at marriage. Both are non-trivial changes in the average age at marriage, especially given the number of women in each occupation. Female wage rates have a significant effect on the age at which a woman marries; a twelve shilling per week (just under one standard deviation) increase in a woman's wage leads to nearly a 0.2 year increase in the average age at marriage. This is, again, a non-trivial change.

What then of the fertility decision over all marriage durations? Although the results are less robust than those for the nuptiality model, the R^2 results (0.45) are still respectable for a cross section model. In this equation, the male wage assumes importance. Increases in the male wage, our proxy for wealth and lifetime earnings, act to decrease the number of children the couple desires/has. The positive coefficient on the square of the male wage indicates that the effect of an increase in the wage increases as the wealth/wage increases. As wage rates, and wealth, increase couples may be choosing to have fewer children and invest more in each child, the Becker quantity-quality trade-off. Wealthier couples may be choosing assets other than children to insure against disability or early death of the male partner, or to save for their old age and retirement. The probability that a man dies before age 35 is significant in determining fertility, but has the opposite sign to what was expected. A 10% increase in the probability of dying young leads to a 0.2 decrease in the number of children per couple. The unexpected sign on the probability of dying young may be due to the fact that the Census of Fertility only includes current marriages and the data do not allow for remarriage. The lack of significance of child mortality may

indicate that women/couples have already factored the expected mortality of their children into their plans for marriage and number of births, and do not "replace" lost children.

What then of the explanations for nuptiality and fertility over different marriage durations? Our results are given in Tables 4 and 5. It is clear that no matter what the duration of marriage, the decision a) when to marry and b) how many to have was a joint one. Estimation by marriage duration did not change these findings. Durations of marriage of 0-2 years, 2-5 years, 5 -10 years and 15-20 years were estimated separately. As can be seen in Tables 4 and 5, the same pattern of significance in the coefficients is apparent in all 4 regressions. The probability that that the husband will die early is significant and negative in all four nuptiality equations and in three of four fertility equations. In the longest durations, 15 to 20 years, child mortality lowers age of marriage but does not affect the number of children per woman, indicating that couples factor in their expected loss when determining how many children to have. Since child mortality is significant at shorter durations, couples are making lifelong plans which can be disrupted by the early death of one partner.[21] The negative (and significant) sign of the coefficient on the probability that the husband dies early may indicate that women who marry into occupations with high probabilities of men dying very young prefer to avoid being widowed with small children and allow for the formation of a "second family" with a possible second husband.

It is also apparent that the risks of dying early had a powerful effect on the timing of marriage. This finding applies whether couples had been married for less

than two, for between two and five or between five and ten years. To that extent, recent work on occupational mortality is shown to have an important if not key effect on the timing of marriage. Where there was good reason to believe that the husband could die before he reached the age of 35, couples tended to marry early. The 'delayed' response of fertility behaviour to economic transition may reflect the truism that many men died early as a result of occupational disease and accidents.

Tables 4 and 5 about here

Our results indicate that childhood mortality was an important explanation for the timing of marriage over all marriage durations. Despite the secular decline in mortality from common childhood illnesses, for example, measles, scarlet fever and diphtheria, (Hardy, 1993; Woods and Shelton, 1997) that decline was insufficient to persuade couples that children born were likely to survive. The 'knowledge' that children born stood a high risk of dying prompted many couples to marry and start having children early.

IV Conclusion

This research has answered but also posed many questions. The approach pursued in this article has been to argue that recent work on the occupational costs of disease and of childhood illness needs to be incorporated into our understanding of nuptiality and fertility behaviour in early twentieth century England and Wales. The message is clear: occupational mortality and morbidity and childhood illnesses and death can no longer be assigned to specialist studies independent of their full demographic effects. To what extent changes in childhood and occupational mortality changed over time –

and over cross section (occupation) in the twentieth century is a question only future researchers can answer.

As it is, our research suggests that in the early last millennium women faced a tortuous choice: if they wished to have any defined number of children and they wished to marry a man employed in certain occupations, they had little choice but to marry early and have their children as soon as possible. Such were the 'real-life' decisions faced by women nearly a hundred years ago. One wonders to what extent women in the developing nations, especially in the face of HIV/AIDS today, face similar choices – and decisions.

Table 1: Male Earnings: 1900/1906

	Male Waged/Salaried Income
Mean	44.36951
Median	32.33000
Maximum	400.0000
Minimum	18.75000
Std. Dev.	49.05080
Skewness	5.366930
Kurtosis	36.46954
Jarque-Bera	4169.562
Probability	0.000000
Sum	3593.930
Sum Sq. Dev.	192478.4
Observations	81

Source: wages are a combination of 1906 Parliamentary/Board of Trade data. Data from years other than 1906 are deflated to 1906 levels.

Table 2: Occupations with highest and lowest male life expectancies (average age of death, 1890/1900)

a) Highest

Occupation	**1890/2 mean age of death *occupied only***	**1900/02 mean age of death *occupied only***
Clergyman, priest, minister	70	71
Barrister	62	62
Farmer, grazier, farmer's son	69	68
Farm labourer, farm servant	66	68
Silk, satin, crape etc	66	67

b) Lowest

Occupation	**1890/2 mean**	**1900/02 mean**
Inn, hotel - servant	39	38
Commercial clerk, insurance service	44	44
Railway engine driver, stoker	44	45
Railway guard, porter, pointsman	45	47
Railway official, clerk	45	47
Printer	45	46
Law clerk	46	46
Domestic indoor servant	47	46
Draper, manchester warehouseman	47	48
Brass, bronze-worker	47	48

Sources:

Supplement to the 45th Report of the Registrar General, C-4564, Report by W.Ogle, PP 1884-5, Vol. XVII, C-4564, Table J, pp. xxv-xxvi; Supplement to the Registrar General's 55th Annual Report, PP1893-4, Vol. XXIV, Part II, pp. 124-130, PP 1905, Vol.XVIII, 6th Anual Report: Part 2: Cd. 2619, Table 2, pp cxxxiv-cxl.

Table 3: Econometric Results: Marrriage Durations 0 – 25 years

	Age at marriage	**Births per woman**	**Age at Marriage**	**Births per woman**	***Mean & std deviation***
constant	29.57 (36.57)	15.10 (7.23)	30.03 (31.01)	17.56 (1.87)	
Age at marriage		-0.436 (-6.62)		-0.557 (-1.58)	25.22 yr (1.13)
Births per woman	-0.718 (-2.36)		-0.895 (-2.90)		2.79 (0.619)
Childhood mortality	-12.08 (-5.72)	-3.09 (-1.57)	-12.71 (-6.48)	-4.68 (-0.87)	17.2% (4.7)
Female wage	0.016 (2.56)		0.013 (2.05)		16.71 s/w (12.55)
Male wage		-0.010 (-3.29)		0.0010 (0.089)	44.37 s/w (49.05)
Male wage squared		0.00002 (2.88)		-2.1E-06 (-0.09)	3984.00 (16439.9)
Die_early	-0.028 (-5.17)	-0.022 (-3.32)	-0.016 (-1.93)		19.71% (8.01)
Die_late				0.0013 (1.57)	54.84 (83.37)
Determinant residual covariance (J-statistic)	0.0334 0.1211		0.0258 0.1488		
R^2	0.77	0.45	0.76	0.43	
n	79	79	79	80	

t-statistics in parentheses
s/w = shillings per week, 1906

Table 4: Econometric Results: Different Marrriage Durations 0 to 2 years and 2 to 5 years

	Durations 0 to 2 years			Duration 2 to 5 years		
	Age at marriage	Births per woman	Means & (std dev)	Age at Marriage	Births per woman	Means & (std dev)
constant	32.65 (69.40)	2.96 (25.50)		28.46 (36.02)	0.55 (0.49)	
Age at marriage		-0.091 (-22.26)	26.27 yr (1.28)		0.005 (0.14)	25.86 yr (1.26)
Births per woman	-11.04 (-22.77)		0.367 (0.074)	-0.054 (0.14)		1.20 (0.549)
Childhood mortality	-9.43 (-4.18)	-0.852 (-4.15)	17.2% (4.7)	-15.95 (-4.99)	3.19 (2.80)	17.2% (4.7)
Female wage	-0.0006 (-0.22)		16.71 s/w (12.55)	0.054 (3.99)		16.71 s/w (12.55)
Male wage		-2.45E-5 (-0.01)	44.37 s/w (49.05)		-0.0008 (-0.87)	44.37 s/w (49.05)
Male wage squared		-2.32E-8 (-0.06)	3984.00 (16439.9)		-1.50E-07 (-0.08)	3984.00 (16439.9)
Die_early	-0.038 (-5.04)	-0.003 (-5.14)	19.71% (8.01)	-0.034 (-3.55)	-0.002 (-0.64)	19.71% (8.01)
Determinant residual covariance (J-statistic)	.0000267 0.1189			0.1677 0.0975		
R^2	0.66	0.16		0.58	0.07	
n	79	80		79	80	

t-statistics in parentheses

Table 5: Econometric Results: Marriage Durations: 5 to 10 years

Table5	Duration 5 – 10 years			Durations 15 – 20 years		
	Age at marriage	Births per woman	Means & (std dev)	Age at marriage	Births per woman	Means & (std dev)
constant	31.89 (26.99)	13.82 (9.66)		29.22 (39.71)	23.96 (5.38)	
Age at marriage		-0.42 (-8.45)	26.27 yr (1.28)		-0.788 (-5.19)	24.83 yr (1.12)
Births per woman	-1.87 (-3.33)		0.367 (0.074)	-0.506 (-2.37)		3.87 (0.87)
Childhood mortality	-10.51 (-3.40)	-3.87 (-2.94)	17.2% (4.7)	-12.42 (-3.28)	0.99 (0.27)	17.2% (4.7)
Female wage	0.010 (1.21)		16.71 s/w (12.55)	0.011 (1.82)		16.71 s/w (12.55)
Male wage		-0.001 (-0.50)	44.37 s/w (49.05)		0.0001 (0.19)	44.37 s/w (49.05)
Male wage squared		3.02E-06 (0.51)	3984.00 (16439.9)			3984.00 (16439.9)
Die_early	-0.037 (-4.12)	-0.019 (-4.91)	19.71% (8.01)	-0.025 (-3.56)	-0.032 (-4.57)	19.71% (8.01)
Determinant residual covariance (J-statistic)	0.0095 0.0334			0.1354 0.1357		
R^2	0.70	0.48		0.57	0.47	
n	89	85		89	70	

t-statistics in parenthes

Appendix 1: Occupations and Fertility and Mortality
Variable Definitions and Sources

Variables	Definition/Source
Occupation	Occupational title/classification, 1871 Registrar General's Report, beginning page 450
1871	Code number from the 1871 Registrar General's Report
census	Code number from the 1911 Fertility Census for the matching occupation

Nuptiality and Fertility Variables

Age m	average age at marriage; calculated from Tables 30, 35; 1911 Census Ave m = {17.5*number of women married at ages 15 –19 + 22.5 * number of women married at ages 20 –24 + 27.5 * number of women married at ages 25 – 29 + 32.5 * number of women married at ages 30 – 34 + 40.0 * number of women married at ages 35 – 44} / total number of women married for the given duration. calculate by length of time married (duration)
age m02	average age at marriage for women married 0 – 2 years
age m25	average age at marriage for women married 2 – 5 years
age m510	average age at marriage for women married 5 – 10 years
age m025	still to be calculated: average at married for women married 0 – 24 years (< 25 years)
total child	total number of children born to women of a given duration.
Child 02	total number of children born to women married 0-2 yr.
Child 25	total number of children born to women married 2-5 yr.
Child 510	total number of children born to women married 5-10 yr
Child 025	Still to be calculated for women married < 25 yrs.
Women xy	total number of women married for x – y years, 1911 Fertility Census, tables 30 & 35; equals the sum of women married, by occupational category, at all ages for a given duration of marriage.
Women 02	total number of women married 0 – 2 years, 1911 Census
Women 25	total number of women married 2 –5 years, 1911 Census
Women 510	total number of women married 5 – 10 years, 1911 Census
Women 025	total number of women married < 25 years
B/W	births per woman for a given duration of marriage B/W = total number of children born / total number of women of the given duration
B/W 02	births per women married 0 – 2 years; = child 02 / women 02

B/W 25 births per woman married 2 – 5 years; = child 25 / women 25
B/W 510 births per woman married 5 – 10 yr; = child 510 / women 510
B/W 025 births per woman married < 25 years = child 025/women 025

Infant and Child Mortality Variables

Child die number of children of women of a given duration who died before the Census date.
Ch die02 number of children of women of duration 0-2 who died
Ch die25 number of children of women of duration 2-5 who died
Ch die510 number of children of women of duration 5-10 who died
Chi die 025 number of children of women married < 25 years who died

INF mort infant mortality; fraction of children born who died before the Census date.
INF mort = total child / child die
INF 02 fraction of children who die, born to women married 0-2 yr
INF 25 fraction of children who die, born to women married 2-5 yr.
INF 510 fraction of children who die, born to women married 5-10 yr.
INF 025 infant mortality for women married < 25 years.
CHILD_Mort name used in EVIEWS data set for inf 025

Mortality Variables

Aged 71 average age at death for men over the aged 20 and older, by occupation, in the 1871 Registrar General's Report.
= (22.5 * number of men died aged 20 –25 +
30.0 * number of men died aged 25 – 35 +
40.0 * number of men died aged 35 - 45 +
50.0 * number of men died aged 45 – 55 +
60.0 * number of men died aged 55 – 65 +
70.0 * number of men aged 65 – 75 +
88 * number of men died aged 75 and older) / total number of men who died at ages 20 and above.

Model 71 modal age at death for men aged 20 and older, in the 1871 Registrar General's Report.

Aged 90 average age at death in 1890/1892, Registrar General's Report
Aged 00 average age at death in 1900/19002, Registrar General's Report

Appendix 2: Occupations with the highest/best and lowest/worst values

Age at Marriage	**Births per woman**	**Child Mortality**	**Die early (age < 35)**	**Die late (age > 55)**
oldest	***fewest***	***lowest***	***lowest***	***highest***
Clergy 29.4	Doctors 1.1	RR officers, clerks 5.5	Clergy 5.1	Clergy 78.1
Gentlemen 28.6	Actors 1.4	Solicitors 7.5	Gentlemen 5.1	Gentlemen 78.1
Doctors 28.1	Gentlemen 1.5	Clergy 7.6	Bailiffs 6.2	Bailiffs 75.3
Domestic servants 28.0	Domestic servants 1.6	Authors, editors 9.2	Market gardeners 7.8	Wool spinners 72.5
Solicitors 27.8	Architects 1.8	Architects 9.4	Doctors 10.1	Agricultural labourers 71.3
Architects 27.4		Gentlemen 10.2	Solicitors 10.3	Solicitors 59.4 Doctors 59.3 Architects 50.9
youngest	***highest***	***highest***	***highest***	***lowest***
Coal miner 23.3	RR officer, clerk 4.8	Shipyard labour 41.6	Inn, hotel servants 44.4	Nurseryman 9.4
Cutler 23.7	Dock/wharf labourer 3.8	Iron manufacture 31.6	Commercial clerk 38.5	Inn, hotel servants 13.2
Glass manufacture 23.7	Iron manufacture 3.7	Dock, wharf labourer 25.1	Insurance clerk 38.5	Insurance clerks 26.4
Shipyard labourer 23.7	Brickmakers 3.7	Iron foundry worker 23.8	RR driver, stoker 38.2	RR driver, stoker 26.9
Brass manufacture 23.7	Steel manufacture 3.7	Culter 23.5	Printers 37.2	Printers 28.4
Boilermakers 23.8	Coal miner 3.6 (8^{th} highest)	Coal miner 23.4	Coal miners 27.3	
				Coal miners 40.7 (high morbidity)

APPENDIX 3: EVIEWS DATASET

INF mort	INF 02
CHILD mort	INF 025
Aged 71	average age at death, 1871
Moded 71	modal age at death, 1871
Aged 90	average age at death, 1890
Aged 00	average age at death, 1900
Morbidity	percentage of men who die of lingering disease/disability See list
Die early	proportion of men (by occupation) who die before age 35, 1890
Die late	proportion of men (by occupation) who die after age 55, 1890
Agem 025	average at marriage for women married < 25 years, 1911
Child 025	number of children born to women married < 25 years
Ch die 025	number of child born who died
Women	number of married women/couples, 1911
BW xx	births per woman; number of children born/number of women

I = occupation

Wages

F wage	female wage rate, primarily BOT 1906, Holcombe 1973, Cadbury and Matheson 1909; weekly wages in 1906 shillings
M wage	male wage rate, primarily BOT 1906, Routh, 1980, Perkin 1989; weekly wages in 1906 shillings
Routh_w	wages from Routh, 1980; in 1906 pounds per year
Class	derived from Routh, social classification of occupations; 9 point, ordinal scale

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[1] See, for example, Boyer and Williamson, 1989; Coale and Watkins, 1986; Crafts, 1984 and 1989; Haines, 1989; Szreter, 1996; Teitelbaum, 1984; Woods and Smith, 1983).

[2] Although we should note that Szreter (1993) has argued that notions of an economic transition can be unhelpful in our understanding of fertility behaviour over time.

[3] Although, as we argue below, these data are not without their problems.

2 See Szreter, 1996.

3 In 1884 the death rate per million of children under 14 in England and Wales from Scarlet Fever was 473; by 1900 it had risen to 856 but fallen by 1909 to 462; the equivalent figures for Diphtheria was 646 (1889), 340 (1900) and 273 (1909), and for measles, 419 (1884), 394 (1900) and 356 (1909). Source: Annual Report of the Registrar General.

[4] Child mortality (fatalities per child born) were 0.42 in the children of male shipyard labourers, 0.34 of seamen, 0.32 of those employed in iron manufacture; 0.29 and 0.24 amongst skilled and unskilled workers in iron foundries respectively and 0.25 amongst dock and wharf labourers. Source: 1911 Fertility Census, Tables 30 and 35. See also Guinnane who finds a role for social effects in the explanations of the determinants of fertility in Dublin at this time.

[7] Child mortality (fatalities per child born) were 0.1 in the children of accountants, architects, civil engineers and authors/journalists; 0.08 amongst bankers and clergy, 0.07 amongst solicitors and 0.06 amongst gamekeepers. . Source: 1911 Fertility Census, Tables 30 and 35

[8] Infant mortality rates amongst civil servants and bankers were 0.05; amongst architects and authors/journals 0.047; amongst doctors 0.04; amongst solicitors 0.036; amongst civil engineers and the clergy 0.35; amongst shopkeepers and naval officers 0.02.Source: 1911 Fertility Census Tables 30 and 35

[9] Infant mortality rates amongst couples where the husband was employed as an unskilled foundry worker were 0.17; amongst cutler and scissors makers 0.16; amongst iron manufacture workers and shipyard labourers, 0.15; amongst workers in earthenware manufacture 0.15; amongst costermongers and workers in glass and bronze manufacture and dock labourers 0.14. Source: 1911 Fertility Census, Tables 30 and 35

[10] Median and mean infant mortality rates of 0.187 and 0.185 respectively, compared with median and mean infant mortality rates for couples married over all durations of 0.094 and 0.095 respectively.

[11] Infant mortality rates for couples married between 5 to 10 years where the husband was employed as a shipyard labourer were 0.205; as a dock or wharf labourer and unskilled iron foundry worker 0.0199, as a steel manufacturing worker 0.194 and as a costermonger/pedlar 0.193.

[12] The data were derived primarily from Board of Trade, Enquiry into Earnings and Hours Report (1906) supplemented by data from Routh, (1980) and Perkin (1989).

[13] From Routh, (1980) in 1906 pounds per year

[14] In 1890, the mean age of death of a clergyman was 70. By 1900 this had risen to 71. By contrast, a brass or bronze worker had an average age of death of 47 in 1890, rising to only 48 in 1900. Registrar General, *Supplement to the 55th Annual Report of the Registrar-General*, PP 1897, Vol. XXI

[15] Less than 10 per cent of deaths recorded in these occupations were of men who died before the age of 35. Registrar General, *Supplement to the 55th Annual Report of the Registrar-General*, PP 1897, Vol. XXI

[16] Just over 25 per cent per cent of deaths recorded in these occupations were of men who died before the age of 35. Registrar General, *Supplement to the 55th Annual Report of the Registrar-General*, PP 1897, Vol. XXI

[17] The relevant percentages of deaths under 35 as a percentage of all deaths in these occupations were Coal-miner in South Wales (35%), Hairdresser (34%), Zinc Worker (30%), Railway Driver (38%) and Printer (37%).

[18] Wages are a combination of 1906 Parliamentary/Board of Trade data and estimates from Holcombe, (1973); Cadbury et. al.,(1909), Routh (1980) and Perkin (1989). Data from years other than 1906 are deflated to 1906 levels.

[19] Occupational differences were also noted by Pollard. See also Pollard, (1959).

[20] We used a generalized method of moments to test the above which was robust under a wide range of distributional assumptions.

[21] The number of observations for duration 15- 20 years is different due to the change in instruments used to estimate the system. The square of the male wage is insignificant and was eliminated.