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Introduction

What can economics bring to the study of such diverse phenomena as the choice of hospital for elective operations and individuals' decisions on fertility? In this dissertation, both subjects are treated using an approach that is common to most studies within the field: analysing trade-offs, assuming rational choices and utility-maximizing behaviour. Human capital is a central concept in all three analyses in this dissertation. I will first give a brief presentation of this analytical tool, and second, explain how it relates to my work.

In a narrow sense, human capital refers to the productive capacities of human beings as income-producing agents in the economy. Education is the most common example of investment in human capital. However, I will use human capital in a broader sense that also includes a person's health endowment. Human Capital Theory emerged in the 1960s and 1970s and the fundamental conceptual framework was provided by Gary Becker (1964). Becker describes it as follows: "Human capital analysis starts with the assumption that individuals decide on their education, training, medical care, and other additions to knowledge and health by weighing the benefits and costs" (Becker, 1993, p. 392). The theory has applied well-known concepts like investment, rate of return and depreciation in a novel way and has provided explanations of human behaviour in a number of fields, including fertility and the demand for health services.

In his Nobel Lecture, Becker admitted that he had been in doubt about titling his 1964 book *Human Capital* because the term "...was alleged to be demeaning because it treated people as machines" (Becker, 1993). However, Becker also pointed out that education offers non-pecuniary and non-market types of return (Alstadsæter, 2003). One of his students, Michael Grossman (1972a, 1972b), developed what is now known as the classical model of demand for health. In the model, health capital is seen as one component of the stock of human capital: being in good health yields utility in itself as well as income through market production. Health as an investment commodity determines the total amount of time available for market and non-market activities. Health is produced by means of the individual's use of his or her own time and services bought in the market. Thus, the demand for health services is in turn derived from the demand for health. In Grossman's model, the private return to investment in health may, broadly speaking, be measured by the number of illness-free days that an individual enjoys in any given year. Likewise, education that increases productivity will, in a perfect labour market, yield a return through higher wages.

In addition to the private return, however, investments in health and education can also yield a social return, i.e., to persons other than the one undertaking the investment. In the health domain, one person's lifestyle may bear consequences for other peoples' behaviour, e.g., smoking, eating habits, or level of activity. The social return to education is commonly associated with the diffusion of general knowledge, which makes other persons more productive (Lucas, 1988). Education may also have externalities in more subtle ways, e.g., through implications for the pattern of human fertility.

Like other forms of capital, human capital will depreciate. Education, skills and knowledge are forgotten or can become obsolete. Relating the human capital terminology to hip replacements, we can say that the demand for an operation is derived from the demand for health. Even from birth, people differ in their health stock: some patients can have a hip defect from when they are only a few months old (developmental *dysplasia* of the hip). Over time, the hip joint can also be damaged from long usage, so *arthritis* is the most common cause of hip replacement.

As pointed out by Kenneth Arrow (1963) in his seminal article, the health-care sector is characterized by a high degree of asymmetric information, e.g., the patient does not know which treatments are available for a particular illness and cannot easily compare the quality of

health services offered. Arrow suggested that such asymmetries help explain why non-market health institutions arise. Several countries where health services are publicly financed have initiated competition in the health-care sector through patient choice of deliverer (Siciliani and Hurst, 2005). These reforms aim at improving efficiency by letting patients travel to institutions with idle capacity. The patients' motives for travel could be that the expected health improvement provides a higher quality of life, reflecting in turn the consumption aspect of health. Therefore, waiting for an operation bears a cost. Another cost of waiting could be the income foregone when the patient is excluded from the labour force due to illness. This reflects the human capital aspect. This brief overview presents two potential explanations for why education can be important for patient choice of hospital: the opportunity cost of time and information cost. Our analysis in chapter 1 investigates patients' preferences along several dimensions, one of which is education.

Economists have used human capital theory to explain the pattern of fertility. Hotz, Klerman and Willis (1997) give an overview of the literature. The basic idea is that taking care of children is time-intensive, and that the opportunity cost of time increases with education. As a result, more educated parents want fewer children, but may spend more resources on each child's education and upbringing (Becker, 1960; Willis, 1973). Gustafsson (2001) summarizes the theory on the timing of births and identifies the main factors as career planning and consumption smoothing. Gustafsson concludes that the main parameters that have an impact on career costs are the amount of pre-maternity human capital, the rate of depreciation of human capital from the non-use of human capital, the rate of return to human capital investments, the profile of human capital investments and the length of time spent out of the labour force. Chapters 2 and 3 elucidate upon the connection between education and fertility, analysed over the ages during which women are fertile. The outcome variables are the timing of first births and number of children, including childlessness.

A methodological problem when examining the link between education and fertility is how to identify the causal relationships. For instance, when the data show that the number of children decreases with education, is this because more educated parents wish to have fewer children because of the higher opportunity cost of time, or because individuals have different preferences that influence their choice of schooling as well as fertility? One way to overcome the identification problem is to employ "natural experiments", (see e.g., Angrist and Krueger, 2001). The fertility analysis in chapters 2 and 3 benefits from such a natural experiment: namely, an educational reform implemented in Norway from 1960 to 1972.

All articles analyse discrete choice, and a common feature is the use of a latent variable model where it is assumed that part of the utility derived from each alternative is observable to the researcher, and part is unobservable and treated as a random variable. Patient choice is estimated using a conditional logit model and fertility with a logit model. The fertility analysis is reduced-form estimation, while we use a structural model for the choice of hospital and estimate the marginal rate of substitution between distance and waiting time. Thus, in chapter 1, preferences are described, whereas in chapter 3, I examine factors that can shed light on how preferences are formed. Economists have become increasingly aware of the importance of the family as an institution for shaping values and habits. In this dissertation, teenage motherhood is analysed in terms of its relationship to schooling, as well as to family background and social interaction.

Summary of the chapters

The dissertation consists of three self-contained chapters. Chapter 1 makes use of a unique set of patient data originating from the Norwegian Arthroplasty Register and merged with data from the Norwegian Patient Register, Statistics Norway and a matrix of distances to

investigate the impact of patient characteristics on the choice of hospital for elective care. Chapters 2 and 3 use a very rich data set of register data from Statistics Norway to analyse the causal determinants of fertility choices among Norwegian women, and the heterogeneity in their responses to educational reform and the effects of social interaction. The following provides a brief summary of each chapter.

Chapter 1: Patients' Preferences for Choice of Hospital (Co-authors: Birgitte Espehaug and Lars Birger Engesæter)

Irrespective of the health system, patients' choice of hospital may be considered as the trade-off between price, distance and quality. In a national health system (NHS) where hospital treatment is close to free of charge at the point of treatment, price is irrelevant to the patient, but waiting lists typically occur (Cullis, Jones and Propper, 2000). These have been given considerable political attention. In fact, waiting time is one aspect of quality that is highlighted in health policy in several OECD countries. One of the supply-side policies used to reduce waiting time is to increase patient choice, and thereby enhance the competitive pressures on providers (Siciliani and Hurst, 2005). A recent ruling in the European Court of Justice extends patients' legal rights of choice dramatically within the European Union, as it gives patients within a NHS the option of publicly funded treatment abroad if they face any undue delay. In Norway, a reform launched in 2001 established a quasi-market for elective hospital care with the aim of equalizing waiting times across the country and improving capacity utilization. However, will paving the way for "market forces" in the hospital sector make any difference? To what extent a European or a national health market will emerge, depends, among other things, on patients' willingness to travel to reduce waiting time. As the willingness to pay for shorter waits may rarely be observed in the market, it must be inferred from actual behaviour or from surveys (Cullis *et al.*, 2000).

The contribution of this paper is to empirically analyse quality competition, focusing on the demand side and, more specifically, the trade-off between waiting time and distance. This trade-off is likely to differ between patient groups, and it should be easier to interpret the results when we focus on only a single patient group. In our analysis, patients' preferences are derived from their actual behaviour within a national health system, using a unique set of register data with individual patient information on socio-economic variables as well as medical data. Patient choice is analysed within a random utility framework using a conditional logit model.

We examine patients' preferences using data from 2001 to 2003 on patients undergoing primary total hip replacement (Furnes *et al.*, 2003). This is an interesting patient group for several reasons. First, hospital choice is an option for elective cases only, of which hip replacements constitute a large share (Christensen and Hem, 2004). Second, waiting times for this sort of treatment were substantial when the free choice reform was introduced: on average thirty weeks at a national level, notwithstanding large geographical variation. Third, the procedure is offered at many hospitals across the country.

The average age of the patient group is high, nearly 67 years. Quality differences among hospitals have been detected, as the risk of revision is found to be less in hospitals where surgeons perform a high number of operations each year (Espehaug *et al.*, 1999; Losina *et al.*, 2004). Because total hip replacement is a quite common type of surgery, we would expect general practitioners (GPs) to have a general opinion on the quality of different hospitals. The fact that information on prostheses survival related to individual hospitals or surgeons is not published in Norway should not rule out competition based on general reputation or observable quality aspects such as waiting time.

A general finding in the literature on hospital choice is that distance is important. Tay (2003) refers to studies that identify various proxies for hospital quality: capacity, high volume, the range of services, the complication rate, the mortality rate, etc. For hip replacements specifically, the quality criterion most often used in the medical literature is survival of the prosthesis. In this study, we assume that quality aspects other than waiting time are captured by a set of hospital dummies. These dummies represent various dimensions of perceived quality that are fixed within the study period, and in principle observable both to the patient and to the researcher, but not included separately in the analysis, e.g., university hospital status or general reputation.

We find that distance is a very important attribute when patients consider hospital choice for elective hip replacement. Waiting time is also estimated to be statistically significant and to have a negative effect on utility, but its impact on behaviour is found to be small. Given the marginal effect of waiting time on utility is found to be negative rules out the possibility that long waiting lists can be regarded as a signal of good quality. The model includes a hospital-specific fixed effect, which should cover time-constant effects, such as reputation.

The estimated trade-off between distance and waiting time varies considerably between models and patient categories. Patients are categorized according to age, gender, education and the year of referral. Avoiding distance is especially important to older patients, and the estimates show no statistically significant gender differences. Clearly, the most important factor for the estimated marginal rate of substitution is the level of education. Irrespective of age, gender and the year of referral, a patient with more education is more willing to travel and less willing to wait. In the estimated sample, the mean patient in each category is less reluctant to travel for an operation in 2003 than in 2001, although this result is not robust to changes in sample size.

The most striking finding is the great reluctance to travel among patients having a primary hip replacement. The most mobility-inclined patient (as measured by the marginal rate of substitution), represented by a man under the age of 67 years with higher education who entered the waiting list in 2003 must, on average, benefit from a reduction in waiting time of 32 weeks to be willing to travel just one extra hour.

Chapter 2: Education and Fertility: Evidence from a Natural Experiment (Co-authors: Carol Propper and Kjell G. Salvanes)

Fertility continues to be an issue of public concern, even in developed countries that have experienced the demographic transition and reached a state where both mortality and birth rates are low. Low population growth and higher dependency ratios are argued to strangle economic growth. Recent OECD projections suggest that, because of demographic changes, the growth rate of per capita income will decline from 1.7% to 1.1% by 2050 in European countries and from 1.7% to 1.2% in the United States (Turner *et al.*, 1998). Often when low birth rates and fertility patterns are discussed, women's trade-off between childcare and education and employment opportunities are brought forward as one explanation. The observed relationship between fertility and female education varies between different countries and time periods, but there is much empirical support for strong correlations (Schultz, 1997; Cochrane, 1979). However, many factors influence decisions on fertility, education and employment, very likely including unobservable factors that cannot be controlled for. Thus, causation is difficult to establish. In this paper, we make use of an educational reform to trace the causal effect of education on fertility outcomes.

Nordic countries have a relatively high fertility rate (Sleebos, 2003), but this is an imperfect measure of long-run fertility as it aggregates behaviour over cohorts and ignores the timing of births. With respect to population development that is sustainable, the major

concern in Nordic countries is the increasing number of childless women and the fact that the younger cohorts of women are having fewer children (Skrede and Rønsen, 2006). Our data enables us to estimate the effect of education on the timing of births as well as completed fertility, including the probability of being childless, after allowing for cohort effects. As the cohorts studied were born between 1946 and 1958, our data includes the most recent generation of women with completed fertility histories.

We study the relationship between the education of women and three fertility outcomes: the timing of children; childlessness; and the number of children. Our data confirms the expected correlation between fertility outcomes and education: women with more education are more often childless; they have fewer children and postpone births. Despite these statistically significant correlations, we do not find evidence of a causal relationship between the length of education on one hand, and completed fertility or childlessness on the other, when using the reform as an instrument for education. Our main finding is that increased mandatory education lead to the postponement of births; there are fewer cases of teenage motherhood and more first births among women aged 35 to 40 years. This result cannot be explained as a mere “incarceration effect”, and we interpret it mainly as a result of increased human capital accumulation from the reform.

Chapter 3: Education and Fertility: Testing for Family Background and Spillover Effect

Studying the causal relationship between fertility and education, Monstad, Propper and Salvanes (2007) find that more education leads women to postpone first births, but that it does not result in lower total fertility or the greater incidence of childlessness. The causality is based on a natural experiment, i.e., an educational reform that increased compulsory schooling in Norway by two years. The effect estimated is by definition a “local average treatment effect” (Angrist, 2004). This naturally raises questions about the generality of the results. Policy measures are often intended to benefit certain segments of the population, which is another reason to study heterogeneity in policy response. Indeed, one of the main aims of the educational reform in question, as stated explicitly in government documents, was to enhance the equality of opportunity along both socio-economic and geographic dimensions (Black, Devereux and Salvanes, 2005a). Furthermore, if education has a causal impact on fertility, particularly the timing of births, this is a potential channel through which education can have distributional consequences across generations.

Investments in education can be evaluated by the private rate of return. If externalities arise, the social and private rate of return will differ (Lucas, 1988). Even if educational reforms are hardly ever implemented because of their effect on fertility, one should bear in mind that such policy measures have fertility consequences and that fertility behaviour implies externalities. For instance, at the macro level, the number of children born and the age structure of the population have implications for economic growth. Research also suggests that teenage pregnancy shapes the life conditions for the child to be born in an adverse manner (for references, see Black *et al.*, 2006). Moreover, motherhood at a later age also can have unfavourable medical consequences for the child: “...more stillbirths, more infant deaths, more premature births, more chromosomatic problems and more learning problems” (Gustafsson, 2001, p. 244).

One way that externalities can arise is that one person’s behaviour and norms may shape another person’s preferences and behaviour. Such spillover effects are a special concern in the “new social economics literature” (Durlauf and Young, 2001). This literature examines such diverse phenomena as residential segregation (Schelling, 1971), neighbourhood effects on teenage childbearing (Crane, 1991) and how the presence of other smokers in a household affects the decision to quit smoking (Jones, 1994). Fertility is influenced by many factors, e.g., economic and cultural factors. It then appears reasonable that the family is an institution

that shapes young girls' values and attitudes towards important decisions, including the choice of education and family formation. In several studies, the characteristics of the family have proven to have a great impact on young people's choice of education, labour market outcomes, etc. (see e.g., Aakvik, Salvanes and Vaage, 2005; Black *et al.*, 2005a and 2005b; Raaum, Salvanes and Sørensen, 2006). In this paper, I examine whether community and family background also play an important role in decisions on fertility, and whether a spillover effect can be traced in the data. Elder relatives (grandparents, uncles and aunts) have been proven to have an impact on educational outcomes for same-gender adolescents (Loury, 2006). I estimate the impact on fertility of elder sisters' education, while also controlling for the mother's and father's education.

The purpose of this paper is twofold. First, to examine the extent to which there is heterogeneity in the response to educational reform, and thereby identify the groups of women whose fertility behaviour changed due to the reform. Second, to examine whether education triggers a spillover effect within the family, so that an elder sister's having more compulsory education has an impact on the younger sister's fertility outcomes, in particular, the probability of teenage motherhood. Moffitt (2001) points to several methodological problems in identifying the effect of social interactions. This analysis benefits from a natural experiment, this help solve the problem of unobservable heterogeneity. Unlike many other studies, the impact of family background is studied within the context where the link between education and fertility is causal.

Family background proves to be an important causal determinant for fertility behaviour in general, but also for the effect of educational reform on fertility. The analysis shows much heterogeneity in the response to educational policy. In particular, the effect depends on family income and whether the young woman lives in a city. The heterogeneity in the response is especially strong regarding the likelihood of first birth as a teenager. The group that responded to the reform most strongly in terms of delaying first birth consists of women from low-income families, living in cities. These women also show an increase in the tendency to remain childless. However, the effect of family background does not seem to incorporate spillover effects of the reform from elder to younger sisters within the same family. The spillover effect of the reform is estimated to have the expected sign (to reduce teenage motherhood), but it is of small magnitude and statistically insignificant.

Regarding the intention to enhance the equality of opportunity, it is worth noting that as a consequence of the reform, the timing of first births and especially the frequency of teenage motherhood has become more similar among the different income groups. Along the urban/non-urban dimension, the picture is more mixed. Using a specification that focuses on the poorest income quartile, I find that the gap between urban and non-urban women is diminished because of the reform.

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