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ABSTRACT

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Typically, when two people decide to become parents, they procreate by copulation and produce a child. What do people do if, for some reason, they can't produce their own children but want to be parents? Today, a prospective parent can go to the web, drop a vial of sperm from a donor with specific selected characteristics into a "shopping cart" and have that sperm delivered in twenty-four hours. Similarly, one can sift through the profiles and pictures of women who are egg donors and select eggs from women with desired characteristics and arrange an egg delivery. These markets are two segments that loosely fall under the rubric of Assisted Reproduction Technologies (ART), which is a shorthand term for the numerous procedures aided by technology used to produce a baby. This primer in the economics of assisted reproduction introduces some of the economic dilemmas brought about by new reproductive technologies. Now the cost of producing children can radically differ among people of similar incomes and values because a prospective parent may have to pay to gain rights to the genetic components that build the child.

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Introduction

Typically, when two people decide to become parents, they procreate by copulation and produce a child. What do people do if, for some reason, they cannot produce their own children but want to be parents? Until recently, if a couple wanted to have children, but was unable to do so because of fertility problems, there were limited options. A couple could adopt a child to become the legal parents of a child who had no legal parents, or could become foster parents, the temporary (and paid) caregivers of a child who still had legal parents. Such activities are historically common and were often market exchanges. Zelizer (1985), noting the importance of the work that foster children provided for their families, claims that "the legitimacy of child labor was essential to early nineteenth-century substitute care arrangements".[1] In fact, child auctions (for fostering) were not prohibited in Sweden until 1918 (Lundberg, 2000). Zelizer also argues that the changing social value of children rendered them as "exclusively emotional and moral assets" who were transformed from economic assets into "priceless" children in the early 20th century.[2] Children may have become recommodified: at the beginning of the 21st century; excess demand for children to adopt in the United States has led to an international adoption market that has greatly increased the supply of adoptable children.

In a sterile sense, a child is built when an ovum is fertilized by a sperm and together they become an embryo. The embryo must reside in a womb for approximately nine months to develop properly into a live baby. Recent developments in biotechnology have expanded the number of ways in which any of these steps can happen. Newer markets are now extensive as the ability to extract, process, freeze, transport, and implant eggs, sperm, and embryos becomes

[1] Zelizer (1985), pg. 171.
[2] Zelizer (1985), pg. 112.

commonplace. Simple sperm or egg 'donation' allows a couple with one fertile partner to acquire the raw genetic material from someone of the opposite sex.[3] Artificial insemination by donor (DI) and fertilization of the ovum in vitro (IVF) are a collection of non-invasive to moderately invasive techniques to fertilize a woman's ovum with a man's sperm.[4] There are relatively few places where these techniques are illegal, although 'donation' of sperms or eggs for money is illegal in a number of places.

With or without these techniques, the embryo must be able to develop in a womb. The market in surrogate motherhood consists of a contractual arrangement where a woman agrees to carry a baby to term for a couple and to give up any parental rights she may have. The baby may or may not have any genetic components of either member of the commissioning couple, or of the surrogate mother.[5] Surrogate motherhood, although it still exists and is legal in some parts of the world, presented both a legal and moral dilemma that, as discussed later in this chapter, nearly destroyed (and significantly reduced) its market.

A final market possibility exists. Reproductive cloning for humans skips the process of uniting egg and sperm and, while still an untested possibility, has raised questions from the religious to the economic. Two sets of economic authors have considered the implications of cloning. Posner and Posner (1999) suggest that, among other impacts, cloning may accelerate the breakdown of traditional roles of men and women as marriage incentives change and as women find fewer incentives to invest in skills that are complementary to men's. Saint Paul

[3] People without partners and gay and lesbian couples are also customers in the market for assisted reproduction.
[4] In in-vitro (glass) fertilization, the egg and sperm are combined outside of the body, typically, in fact, in a plastic petri dish. The first baby born from in-vitro fertilization was called a "test tube" baby.
[5] The surrogate contract itself is actually between the commissioning father and the surrogate mother. The man's partner then enters into an adoption contract after the baby's birth.

(2002:12) concludes that a *Handmaid's Tale* society will emerge under cloning, where there is "a reproductive class at the bottom of the distribution of ability, a productive class at intermediate levels; and a replicated class at the very top of the ability distribution".

All of these markets, with the exception of the market for clones, exist in a number of countries. There is no consensus, though, on the legality of procedures, the enforceability of contracts, nor the acceptance of commercialization. Surrogacy is legal in Spain; accepted in the UK, but not its commercialization; and its procurement is illegal in Denmark. In the United States most assisted reproduction falls under state rather than federal law—meaning that there can be fifty different legal environments for each kind of assisted reproduction, Commercial surrogacy is illegal in Utah (where the law is currently being contested) but legal in neighboring California. Table 1 gives a brief breakdown of current law in a number of European countries and in the United States, [6]

The economics of assisted reproduction is not well understood by economists because it is still a new and rarely studied phenomenon. For this reason, this chapter will not present a standard literature review that summarizes what economists think about assisted reproduction. Instead, we will heuristically proceed with a series of economic explorations related to assisted reproduction to gauge the scope of the issues and how economists might contribute to them. The chapter proceeds as follows. In Section I, we show that economists do discuss the economics of the decision to have children by considering the demand for children. The traditional literature relating to this work is discussed. We briefly mention the issue of supply of children which is not typically modelled in economics because children are assumed to be self-produced. Next, in Section II, is an exploration of the development of markets in assisted reproduction. Even though

[6] Much of the legal and market information in this chapter focuses on the United States. Laws and regulations are changing every day in this arena and may be different from those portrayed here. Also, laws and regulations continue to differ significantly across countries as does prevalence of use of existing markets.

there is a large market in assisted reproduction services (which uses the genetic components of the couple), there will be no analysis of this medical service market in this chapter.[7] After a brief explanation of the size of the market in assisted reproduction in Section III, the discussion in Section IV centers on economic issues in three markets that currently exist: the markets for eggs, sperm, and surrogacy. We draw out the issues of supply and demand in these markets, discuss incentives, excess demand, supply price, reservation price, risk and return, property rights, and altruism. Section V provides a discussion of the ethics of markets in assisted reproduction while Section VI contains some concluding thoughts on the issue from an economist's perspective.

I. The Microeconomics of the Demand for and the Supply of Children (Before Reproductive Markets)

In *An Essay on Population,* Thomas Malthus was concerned about population change but often used individual incentives to explain the demand for children: "The labourer who earns eighteen pence a day and lives with some degree of comfort as a single man, will hesitate a little before he divides that pittance among four or five, which seems to be but just sufficient for one"[8]. Economists have since explored in a more nuanced way how people make decisions about having children and the role of economics in such decisions. In Chapter 5, Steven Stern and Leora Friedberg suggested two reasons why people have children: the biological imperative and the enjoyment children provide. They noted that both factors look the same in a standard economic model because they increase an individual's utility. Let us elaborate on this idea.

[7] A typical example is when the egg of a woman with blocked fallopian tubes is fertilized with her partner's sperm by IVF, then inserted into her uterus. This market is a market for the medical procedure, itself. Hereafter, except where noted, assisted reproduction will refer to the market where some genetic or physical component is purchased rather than the medical procedure itself.

[8] Malthus, www.ac.wwu.edu , Chapter 4.

In the basic microeconomic theory of the family, the demand for children (how many children and the "quality" of children a couple desires) typically depends on the preferences of the parents, the relative price of children, and income. In the simplest model, a couple will maximize a utility function, $U = f(n, q, Z)$, where n is the quantity of children, q is the quality (typically inferred by the time and monetary resources spent on each child) of children, and Z is a composite of all other goods, subject to a budget constraint, which might be specified as $p_c qn + p_z Z = I$, where p_c is the price of each child and p_z is the price of all other goods. [9] The higher the price of children, the lower the demand, and the higher the income, the higher the demand for children (children are normal goods).[10] In general, economists show that couples will trade off quality and quantity of children. Today, most couples choose fewer but higher quality children. Other considerations also arise in these models. For example, higher wage rates for women are negatively related to the demand because of the substitution effect between time raising children and time in the labor market as discussed in Chapter 5. (See also Rosenzweig and Schultz, 1985; Becker, 1981; Applebaum and Katz, 1991).

Until recently, understanding the supply of children was simple and not modelled by economists. Most men produce sperm on demand and can potentially produce millions of offspring. Women are born with all the eggs they will ever produce (up to one to two million eggs), and release one at each ovulatory cycle. Fecundity (the probability of conceiving in any menstrual cycle) is exogenous and random. If a couple wanted to have children, then, with some

[9] There are many microeconomic models of the demand for children, some of them much more complex than this one. For a more in depth look, A Treatise on the Family, by Gary Becker (1981) is a good place to start. Models often differ by whether the couple lives in a more developed or less developed economy.

[10] A conundrum arose when wealthier societies began having fewer children and the relationship between income and the number of children appeared to turn negative. This problem was resolved by asserting that a couple cared not just about the number of children in the family but also about the "quality of children" in the family.

probability, unprotected sexual intercourse would lead to the fertilization of a woman's egg by a man's sperm.[11]

II. The Evolution of Reproductive Markets

Today, a prospective parent can go to the Internet, drop a vial of semen from a donor with specific selected characteristics into a "shopping cart" and have that semen delivered in twenty-four hours. Similarly, one can sift through the profiles and pictures of women who are egg donors and select eggs from women with desired characteristics and arrange an egg delivery. These markets are two segments that loosely fall under the rubric of Assisted Reproduction Technologies (ART), which is a shorthand term for the numerous procedures aided by technology used to produce a baby.[12] Now the cost of producing children can radically differ among people of similar incomes and values because a prospective parent may have to pay to gain rights to the genetic components that build the child. How did we get here?

The rise of assisted reproduction is the story of need and technology changing together. The very first artificial insemination (AI) took place in 1790 in Scotland. In that case, a woman was inseminated with her husband's sperm. Until recently, male infertility was a taboo subject and donor insemination (inseminating a woman with sperm from a man who was not her

[11] Rosenzweig and Schultz (1985:993) rued the absence of an integrated framework to analyze both the demand and supply of children and note that "Economists have recognized the joint relevance of biological and behavioral factors in determining fertility….but this perception has not been suitably incorporated into the empirical study of fertility."

[12] The assisted reproduction literature is rife with acronyms and many of the terms do not yet have a clearly determined definition. The Centers for Disease Control (CDC) in the United States may be unique in that AR only includes techniques where both the egg and sperm are handled in the laboratory. CDC bases its definition on the 1992 law that requires it to produce an annual report on success rates at AR clinics. This means that statistics on the size of the market based on CDC success rates omit all DI or AI procedures where only the sperm is handled by the clinic. Unfortunately, CDC is the repository of clinic statistics. Statistics on sperm donation alone do not appear to exist. In this chapter, all procedures are enveloped by AR as specified above, except where specific CDC statistics are cited.

husband) was a well kept secret. The first known case of donor insemination (DI) occurred in 1884 but not publicly admitted until 1909.[13] Although it was known to be practiced throughout the early to mid 1900s, insemination with live sperm was conducted with discretion, or outright secrecy. Women, or couples, made arrangements privately with a doctor. Who was the father of the child? Various laws made the babies thus produced have tenuous legal standing or made them outright illegitimate in most countries. Religious leaders around the world denounced DI in the 1950s. Indeed, little may have changed if it were not for rapid changes in technology in the 1960s and 1970s: the ability to successfully freeze and use sperm later to develop an embryo (this became crucial later when the AIDs virus became known and almost all doctors ceased using fresh donor sperm) and the technology to fertilize an egg outside of the body and successfully implant the embryo in the womb. Joining these technical abilities was a critical change in law in 1973 in the U.S. which stated that the husband of an inseminated woman was the legal father of a DI baby as long as he knew of the treatment.[14] These, and other rapid changes resolved a number of issues that had relegated DI to the private arena where there was a fragmented ability to procure the components that produce a baby (we might call this an incomplete market); sperm banks could provide women and their doctors with needed sperm on demand. The public market in sperm was born along with the first sperm bank in the early 1970s. California Cryobank, the longest continuously open public sperm bank in the U.S., opened in

[13] According to David Plotz, (2001), the delay was because the case was so shocking.: "Dr. William Pancoast, a professor at Jefferson Medical College in Philadelphia, found that a woman in his care couldn't get pregnant because of her husband's infertility. At the urging of some of his medical students and with the permission of the husband—but not the wife—Pancoast anesthetized her and impregnated her with semen taken from the "best-looking" student in the class. She never was told what was done to her or that her husband was not her child's father. This kind of subterfuge, made-up-on-the-spot, loosey-goosey standards and reliance on overwilling medical students would become the dismal defining qualities of donor insemination (DI)."

[14] The Uniform Parentage Act (1973), attempted to make the laws in all states the same regarding parenthood. There were, and are today, some other conditions on determining the father of a DI baby.

1977. Soon after, Baby Louise, the first baby known to have been successfully born after fertilization outside of the body, "in-vitro", was born in England in 1978.

Assisted reproductive technologies, and the markets that accompanied them, took off. Several historical facts may have sped the development of assisted reproductive technologies. The first is that the baby boom generation, the largest generation in history, reached child bearing age in the 1960s and 1970s, the second is that increasing labour force participation among women led to a delay in childbearing among baby boomers until the ages where infertility was more common, the third is that the resulting soaring demand for adoption, combined with a shortage of children available to be adopted, possibly as a result of the legality of abortion, left many potential parents without children. Medical procedures to eliminate, reduce, or "get around" fertility problems were guaranteed a large market if ethical and legal quandaries could be eliminated. As noted in the introduction to this chapter, such problems were publicly illuminated in surrogacy. Early on, the surrogate's egg was implanted with a commissioning father's sperm. Fears about surrogate mothers who might fight for custody, and a number of court cases where such custody battles took place (raising such legal and ethical questions as "can a baby be owned and, if so, who owns the baby" and "is surrogacy the same thing as selling a baby?") nearly destroyed the market for surrogacy. But the first known baby resulting from embryo transfer (where the egg was not from the woman in whose womb the embryo was implanted) was born in 1984 and gestational surrogacy, where the surrogate carries a baby that is not genetically hers, became popular. [15] This method made the parentage of the baby clearer, was contractually easier to defend, and reduced the prevalence of lawsuits over custody. Indeed, gestational surrogacy, often called "rent a womb", is now the norm.

[15] Jay Mathews, "Boy's Birth is First from Embryo Transfer," Washington Post, February 4,1984, p. A14.

After hundreds of court cases relating to various procedures of assisted reproduction, both the law and market regulation (which had lagged behind the market development) have begun to catch up. The Uniform Parentage Act of 2000 asserts in Article 7, section 702, that "a donor is not a parent of a child conceived by means of assisted reproduction".

III. Assessing the Size of Markets in Assisted Reproduction

How big is the potential market for assisted reproduction (AR)? In the year 2001, there were at least 421 AR laboratories in the U.S. and surrounding territories.[16] The medical characteristics of fecundity along with the medical, demographic and behavioural characteristics of fertility are appropriate preconditions for a potentially large demand for assisted reproduction.[17] According to the Centers for Disease Control, of the 60 million women of childbearing age in 1995 in the U.S., about 13 per cent received an infertility service. If each of these women were to demand some form of assisted reproduction, then, in the U.S. alone, there are at least 8 million potential customers of assisted reproduction. Including others who have not received infertility treatments but who may desire children (say, women without partners or gay and lesbian couples) the potential demand for assisted reproduction is even greater in the U.S. While the potential demand is large, the potential supply is even larger. Each man and woman carries millions of eggs and sperm, but only demands a few to create children for himself or

[16] 384 reporting to the CDC as required by law and 37 clinics known to be operating, but not reporting to CDC (see CDC, 2003b, Appendix C). This does not include sperm banks.

[17] Medical characteristics of fertility include a woman being allergic to her husband's sperm. She is fecund, he is fecund, they just are not fertile together. Demographic characteristics include the decline of fecundity with time. Behavioral characteristics include labor market participation that may be associated with a delay in childbearing until ages when fecundity is low.

herself. If each man and woman produced only enough sperm or eggs to fulfill their own demand for children, then there would be very few people willing to enter the market in assisted reproduction as suppliers. But most people have a substantial oversupply of self-produced sperm and eggs. Thus, our biological characteristics set the preconditions for large markets for eggs and sperm to exist. Further, because problems with infertility can originate with either partner or the combination of people in the couple, the size of each market (sperm, egg, surrogacy) is independently potentially large.[18]

We do know that in the U.S. in 2001, 107,587 procedures were performed by AR as defined by the CDC, resulting in 29,344 live births and 40,687 infants. And the AR market is clearly growing. Just between 1996 and 2001, procedures increased by 66 per cent and live births by 101 per cent. [19] It is difficult to assess actual market size from these CDC statistics, however. They do not include pregnancies resulting from sperm donation when the egg is not handled in the laboratory (underestimating the size of the assisted reproduction market), although they do include the medical procedure of assisted reproduction, using the egg and sperm of the existing couple (overestimating the size of the market). Meanwhile, the CDC reports that there were 571 gestational carriers of fresh eggs in 2001 (2003b). Unfortunately, there are no statistics on the size of the market in surrogate motherhood.

IV. Reproductive markets: Thinking about the Economic Issues

[18] Statistics on infertility tend to be similar across nations. According to one French study, fertility problems originated with the woman in 38 cases out of 100, with the man in 20 cases, and with some combination of the two in 38 cases. In 8 cases, infertility had an unknown source (de la Rochebrochard, 2001).
[19] The Centers for Disease Control and Prevention, 2003b.

As with any economic analysis, we must consider the determinants of supply and demand in each market. The difference here is that there is not a long history of economic analysis of these markets. What are the main issues that have to be addressed and which economic tools may help us do so? These markets are characterized by both profit and altruistic motives of suppliers, varying levels of risk associated with both supply and demand, and prices that depend on the characteristics of suppliers and demanders. To investigate these markets, we will use the rare existent article on the subject and the fundamental tools of basic economics to examine the components of supply and demand. In the following discussion, it will be assumed that contracts (for eggs, sperm, or surrogacy services) are traded.

Supply

Why do people supply their own eggs, sperm, or wombs so that others may have a baby? What are the incentives to supply AR contracts? Many authors have written about the multiple incentives of surrogate mothers, egg and sperm donors. Although a host of reasons lie behind any person's decision, when Klock et al. (2003) evaluated nine possible motivations by querying egg donors about the motivation behind their participation, they, like other authors, found that altruism and compensation together were the primary factors.

Because of these dual motives, the market for eggs, sperm, and surrogacy share the common feature that the supply of contracts can be realized through purchase (where legal) or donation. What does the supply curve look like? For the moment, set aside ethical issues in buying and selling such contracts. If their purchase is illegal, and the "market" supply is restricted by a price equal to 0, then only altruistic suppliers will enter the market (see Figure

1).[20] The supply curve (S_1) is a straight horizontal line at P=0 and ends at the quantity of altruistic suppliers of contracts. If the demand is no larger than the supply at P =0 (D_1), then a price will never arise, and this "market" is in equilibrium. Typically, however, demand is at D_2, the market is in disequilibrium, and there is excess demand for contracts.

Whether or not they agree that a market is the solution, most authors agree that there is excess demand for assisted reproduction, blood supply, and organs (see Ethics Committee of the American Society of Reproductive Medicine, 2000; Harris and Alcorn, 2001; Thorne, 1998). Guerin (1998), for example, writing about sperm donation in France, where, at the time, sperm could only be donated, documents statistics showing that the number of couple candidates for AR with donor semen was six times greater than the number of sperm donors proposing a donation, and up to ten times greater than the number of donors accepted.[21]

There is a growing number of authors who argue that allowing suppliers to be compensated will increase supply, and take care of excess demand. But there is a longstanding controversy over supply behaviour in such markets. If a market emerges in an arena where altruism is an important incentive, then altruists may feel some revulsion (or derive negative utility) when the market emerges and they may refuse to participate. Titmuss (1997) derived supply change predictions when a market for human blood joins a system of donation.[22] It is possible that a market with a positive price could end up with fewer equilibrium contracts traded

[20] Notice that we ignore the cost of medical services, lawyers, and so on. Here we concentrate on the compensation to the supplier of contracts.
[21] His argument, however, is that donation could help eliminate excess demand if recruitment were improved.
[22] The 1997 volume is an expanded edition of Titmuss' classic 1970 volume, *The Gift Relationship*. Market withdrawal was only one component of the argument. Changes in health risks, among other factors, also play an important role in the debate. Arrow and Titmuss argued about these outcomes. For a summary of the issues, see Thorne (1998).

than one with no price at all! To see this, examine Figure 2. Once payment is available, some altruistic donors ($Q_s - Q_r$) may withdraw from the market. Others will enter the market once the price is positive, resulting in the supply curve S_1, that starts at $P = 0$, and looks like a typical supply curve after the supply of altruistic donors is exhausted. If the demand curve is D_1, then the equilibrium quantity of contracts is Q_{m1} and the equilibrium price is P_1. But the equilibrium quantity traded is less than if the price was zero! We believe, however, that D_2 is more representative of demand, and there is a positive equilibrium price, P_2, and a traded quantity of contracts, Q_{m2}, that is greater than Q_s.

Hewitson (1997), in her model of surrogate motherhood, derives a supply curve with these features. In each market (sperm, egg, surrogacy), both altruism and the profit motive are present. What other factors go into the supply function? Ignoring risk (discussed below) each market requires varying level of medical, emotional, and physical time commitment on the part of donors:

- Surrogate mothers must subject themselves to initial medical and psychological exams, and to significant monitoring and restriction of their behaviour during the pregnancy. They may experience disutility from the monitoring required in many surrogate motherhood contracts and from the elimination of behaviours that they may enjoy, but are banned through the contract period.[23] Activities that increase utility will lower the supply

[23] Contracts may specify regular alcohol or drug tests, repeated psychological exams to ensure that the surrogate will willingly give up the baby, and regular medical exams. Surrogate mothers may be banned from extreme physical activity, risky vacations, and smoking. A simple sample contract may be viewed at surromomsonline.com. This sample contract includes language such as: 2) The Surrogate agrees not to participate in dangerous sports or hazardous activities, and promises not to knowingly allow herself to be exposed to radiation, toxic chemicals or communicable diseases. 3) The Surrogate further agrees not to smoke any type of cigarettes, drink alcoholic beverages, or use any illegal drugs, prescription or non-prescription drugs without consent from her obstetrician or midwife.

at each price while activities that reduce utility increase the supply at each price. Further, surrogate mothers may derive utility or disutility from gestating a fetus, birthing a child, and surrendering the baby. Finally, carrying a baby to term is a time-intensive activity and, just as in the demand for children, surrogates' value of time will influence supply at every price.[24]

- Typically, egg donors undergo a several week regime of daily self-injections (hormones to bring more than one egg out during ovulation), a final injection of a different drug to release the eggs, and then an ultrasound and local anesthetic for the egg retrieval. Each of these procedures may reduce utility (and, hence, supply), although the change may be minor.

- There seems to be little outside of altruism and compensation that determines the supply of sperm. If you think about it, this makes perfect sense. While there are some requirements to be met for sperm donors at the major clinics (for example, they must have an initial physical exam, blood draws to test for diseases, and they may have to commit to a period of participation), donating sperm is a non-invasive activity of minimal time commitment, with essentially no medical risk.

Demand

[24] Putting much of this together, Hewitson's supply utility function is $U_i = (\alpha + \beta + \gamma - Mq^*)(\theta + \varepsilon R)(\Pi + A) - \delta\mu A + p\Pi$ where the terms in the first parentheses are parameters of the (dis)utility of gestating a fetus, birthing and surrendering a child, and the monitoring costs of the optimal child quality, the terms in the second parentheses refer to the surrogate's value of privacy and her propensity to engage in risky behaviors. All these are multiplied by either a profit (Π=1) or altruistic (A = 1) contract. Both δ and μ are altruism parameters, and p is the surrogate's compensation.

Why do people demand sperm, ova, or surrogacy contracts and what determines the demand curve? Surprisingly, almost no work has been done on this issue.[25] Looking back to the older literature on the demand for children, however, we can speculate on how the couple's maximization process might be different. Remember that the utility function contains, as its arguments, the number of children, the quality of children, and other goods. In a model of the demand for children via assisted reproduction, the same features will be present with at least one addition: people derive utility from genetic continuity (see Saint Paul, 2002; Posner and Posner, 1999) and so we might see an additional argument that is some function of the genetic makeup of the couple. Of course, genetic continuity was implicitly present before, but since children were self produced, it was unvarying and automatic. What that function looks like is not yet known. However, with assisted reproduction, the level of genetic continuity (genes from both man and woman, from the woman only, from the man only, or from neither) varies as does the price of such continuity. The genetics of the mother and the father may enter the utility function separately. Further, a couple that must include the genetic makeup of another person may want to find a donor who is physically like them (that is, they may want someone of the same race, with the same hair and eye color, and so on as one member of the couple). That is, there may be an argument for 'look and feel' genetics. Finally, there are characteristics that are valued by society (intelligence, beauty, and so on) that may enter into the utility function. This was explicit, but not exclusive to, the "genius" sperm bank, which raised many questions about eugenics and designer babies:[26]

[25] To the author's knowledge, as of January, 2004, there are no published articles in the economics literature on assisted reproduction outside of the Hewitson (1997) article.

[26] The "genius" sperm bank was actually called the *Repository for Germinal Choice* and was founded by Robert Graham. Only men who had won the Nobel Prize could donate sperm. More than 200 babies were born from sperm issued by this sperm bank before it went under (see Plotz, 2001).

> Over the past decade, sperm banks have appeared around the world catering to women clients who care mostly about the physical appearance of the sperm donor. … Fortunately…a few sperm banks select sperm donors mainly based on achievements and intelligence. Their sperm donor catalogs contain extensive information about sperm donors' scientific discoveries and inventions, published papers and patents, school records, music and artistic abilities, athletic abilities, as well as the usual race and appearance information….Genius sperm banks select sperm donors based mainly on achievements and genetic quality rather than based solely on sperm donor appearance, race, and sperm quality. They cater to clients who want to improve the intelligence of their child by selecting a sperm donor of superior intelligence and outstanding achievements. [27]

The demand for children changes markedly under a regime of assisted reproduction when we consider the income constraint. Now, there is a price attached to the birth of each child that was not present before (the additional price of sperm, or egg, or womb and the price of the medical procedures) and there is a price variation attached to the 'quality' of the genetic components (see the discussion on price below). Ceteris paribus, children born from assisted reproduction are more expensive than children born the old fashioned way.

Let us consider just a couple of the implications of these changes in the model. What used to be automatic is no longer so. Couples may now trade off genetic continuity for social value depending on the price. Also, because price can depend on the characteristics of the genetic material, both the price of having a child and the price to produce a certain quality of child can be higher for AR couples (than in the old fashioned case). One potential implication of this is that it is possible that AR couples will have fewer children of lower quality than other couples with the same income and tastes.[28]

[27] http://www.geniusspermbank.com/
[28] This ignores the fact that AR births are much more likely to produce multiple children than old fashioned births.

Risk in demand and supply

Risk is a common attribute of reproduction. The probability that a baby will be conceived in any given reproductive cycle (called the "take home baby rate" in assisted reproduction clinics) is only 20 per cent for couples with past proven fertility and is relatively low in all circumstances of assisted reproduction. The probabilities vary, and are higher for fresh eggs than for frozen (see Table 2). Even though the probability of producing a baby is low for fertile couples, in the typical case there is no cost for a couple to attempt to produce a baby in a given cycle through copulation. But every attempt to produce a child costs if using AR. Typical AR procedures include multiple stages and planned monetary payments at each state—CDC classifies the AR process leading to a child into five stages: cycles started, retrievals, transfers, pregnancy, childbirth. The total cost varies, but can be many thousands of dollars (and the couple may not end up with a child.

Suppose a couple requires a donor egg to conceive a child. Fertility Alternatives is one egg donor agency that posts fees (the fee structures are remarkably similar across the various agencies). Among other charges (it notes that prices will vary widely), Fertility Alternatives requires a profile fee ($25), agency fee ($2500 or 50 per cent of egg donor's fee, whichever is higher), egg donor's fee ($5000-$15,000), facilitator's fee ($250), mandatory health insurance fee ($500), medical screening fee ($800), attorneys' fees ($750), and so on. Other expenses include egg donor travel expenses, lost wages for the donor, all medical expenses incurred by the donor, and all costs of the IVF procedure.[29]

[29] http://www.fertilityalternatives.com/ipfeesed.html for fees above. Studies that examined various economic costs associated with a successful delivery with IVF around the world were collected in Garceau, et al. (2002).

These fees are typically non-refundable if a baby is not produced by the contract. As a question of the economics of childbearing, this risk is critical. First, the cost to "produce" a child is much higher for a couple that requires assisted reproduction. Second, the budget constraint is likely to have a probabilistic function of childbirth in it (a couple could pay for AR, but not end up with a child, making other payments moot). In the end, it may mean that different prospective parents with the same income and the same desired quantity and quality of children (who will face radically different costs to produce children depending on their AR needs and on the probability of child conception) will have different demands for children. Third, in the U.S., all these costs are borne by the prospective parents and none by society. Health insurance still does not cover most AR procedures, and no egg or sperm purchases.[30] As a result, AR contracts will only be demanded by potential parents who have substantial disposable income and who can afford to deal with the probabilistic outcome. Fourth, it is clear that high income couples will make up the majority of demanders of AR. Since income varies by race and ethnicity, demand will subsequently reflect the race, ethnicity and the tastes of high income people.

However, as in many markets where the outcome is risky, an insurance market is emerging. Some donor agencies now offer insurance policies as do many IVF clinics. They are often called "shared-risk" programs.[31] At the moment, these insurance markets carry interesting

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Estimated costs (typically payment of fees by patients) ranged from £10,372 in Finland, to £25,499 in Canada, to £52,566 in the United States.

[30] In contrast, in France, IVF is fully reimbursed by the social security system, in Belgium, Denmark, and Norway, the state bears almost all costs, in England and Wales, some IVF procedures are funded by the National Health System (see Garceau, et al. 2002).

[31] One egg donor agency offers an optional shared risk policy. In the basic plan prospective parents receive a 50% discount on the agency fee for donor matching and coordination of a subsequent egg donation cycle ($375). In the

economic and ethical questions because the insurance market is not independent of the services market. Typically, a client pays a higher fee for IVF by purchasing a policy through the agency. If the procedure is successful, then the agency keeps all fees. If not, a high proportion of the agency's fees (but not, typically drug costs, and other medical costs) is refunded. This results in a funny kind of moral hazard because the agencies themselves provide insurance ("such programs have a built-in conflict of interest which is likely to skew clinical decision-making toward achieving pregnancy regardless of the impact on the patient in order to avoid paying a refund", American Society for Reproductive Medicine Ethics Committee, 1998). Ethically, many believe that shared risk programs violate Opinion 6.01 of the American Medical Association's Code of Medical Ethics, which states that a physician's fee cannot be made contingent on the outcome (ASRM, 1998).

There are many other forms of risk in these markets which must be considered in any economic analysis. Both surrogate mothers and egg donors face medical risks associated with the egg retrieval, implantation, or pregnancy. Often, surrogate mothers lose their compensation under conditions of spontaneous abortion.[32] At this time, there is no insurance market for surrogate mothers who have gone through arduous medical and psychological testing and procedures, but fail to produce a viable baby.

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premium plan prospective parents will pay no agency fee for donor matching and coordination of a subsequent egg donation cycle ($750). .http://www.tinytreasures.50megs.com/contact.html

[32] A spontaneous abortion takes place without any action on the part of the woman carrying the child. While there are a host of reasons for a spontaneous abortion, they often arise when there are severe medical problems with the fetus.

Some forms of risk in the AR market can be classified as property rights risks. Who has legal rights over the baby that is conceived as a result of a contract?[33] The ways in which the property rights risk manifests itself depends on the specific market. As discussed earlier, in the past, legal disputes typically arose in surrogacy because both the commissioning couple and the surrogate mother desired custody. Sometimes, however, it is because there has been some problem with the baby's physical or mental health and no one wants custody of the baby. Surrogates (and, to some extent, egg donors) go through extensive psychological testing to attempt to reduce the risk that anyone who may attempt to claim property rights over the child is eliminated from the pool of suppliers. There has been no such issue for sperm donors (the Uniform Parentage Act of 2000 specifically states that the sperm donor is **not** the father).

Of course, property rights can get complicated both legally and ethically. In surrogacy, there are potentially five people involved in the creation of the baby, each member of the commissioning couple, a sperm donor, an egg donor, and the surrogate. The surrogacy market, in particular, is sensitive to issues of risk and agencies spend considerable effort on risk reduction. First, agencies require the commissioning parents to pay for an independent lawyer who looks out for the interests of the surrogate mother. They also advertise whether any specific surrogate has already had a successful surrogate pregnancy (signaling a lower risk of legal disputes later). Finally, they require commissioning parents to pay for counseling sessions, either with a psychologist, or in a support group of surrogate mothers. These sessions appear designed to help

[33] In fact, one of the big ethical question is whether rights should be thought of as property rights (which turns the baby into property—something we ought not to do).

the surrogate see herself as a temporary caregiver rather than a mother, and this reduces the risk of a custody dispute (Kolczykiewicz, 2003).[34]

Putting Supply and Demand Together

How does one think about price in AR markets? Some people may find it uncomfortable to consider prices for men's sperm and women's eggs. However, as discussed by Peter Moffatt in Chapter 10 on the Economics of Prostitution, economists often work with a concept called hedonic pricing, where an attempt is made to decompose the total price of a product into implicit prices for different traits of that product. So, what are the traits that might be valued in AR markets? Adoption markets (where formal prices are typically illegal) have always been associated with high demand for more desirable characteristics, in particular, race, looks, and health (see Kossoudji, 1990). Current advertising still reflects such attitudes:

> The total expense for an adoption depends on such factors as the child's age and nationality/ethnicity, whether the child has special needs, the specific agency you work with, how long you are willing to wait, what complications arise, and (for foreign adoptions) what country you adopt from. You'll usually find that the costs involved in adopting a healthy Caucasian newborn/infant are higher that in adopting a child of other races, children with special needs, or children from other countries.[35]

Assisted Reproduction markets are slightly more complicated, however. The way that firms advertise their product tells us something about what they believe customers desire (and buy). At least one egg donor agency advertises "Ivy League egg donors". [36] Both sperm banks

[34] My thanks to Mariusz Kolczykiewicz, a former student, for permission to use this surrogacy risk information from a paper he wrote for my class.
[35] http://adoptionservices.org/adopting_families_Adoption_Cost.htm
[36] Tiny Treasures.

and egg donor agencies on the Internet offer extensive information on their donors.[37] Although each agency is unique in the specific information provided in the profiles, a host of characteristics can be found on each individual donor, related to racial or cultural characteristics (self-reported race, ethnicity, father's and mother's race or ethnicity, religion), physical traits (height, weight, eye color, hair color, hair texture, skin tone), health traits (blood type, personality test results, personal medical history, family medical history), and ability traits (level of education, grades, SAT scores, sometimes which university attended, occupation or major at college). Are some of these characteristics worth more than others?

Pricing operates differently in egg and sperm markets. Sperm banks do not typically price an individual donor's sperm. Instead, sperm banks may specialize in donors with particular characteristics. A review of over thirty sperm banks showed a minimum price of $100 per vial, a maximum price of $425 per vial, and a mean price across all sperm banks of approximately $200 per vial.[38] In this sense, sperm banks may operate like firms in a monopolistically competitive industry. There are sperm banks based on religion, ethnicity, and achievements. One sperm bank specializes in sperm from gay men. One now defunct sperm bank specialized in the sperm of Nobel prize winners.[39]

There is at least one sperm bank that prices broadly by education (many sperm banks select donors on the basis of education—in fact, of 1509 donors accessed by the author, not a single one had not been to college). Fairfax Cryobank charges $280 for sperm from men with

[37] Some information is free and public on the web, and some must be purchased. The following quote is from one agency. "California Cryobank (CCB) provides many types of information to help clients select a donor. Long donor profiles, baby photos, audio interviews, Keirsey Temperament Sorter Reports and Facial Feature Reports are available for clients to purchase. Short donor profiles and Staff Impression Reports are available for free." http://www.cryobank.com/pdf/cata03-10.pdf

[38] Author's data set of approximately thirty sperm banks and all of their donors.

[39] The Repository for Germinal Choice.

(or earning) doctorates, $215 for sperm from men without doctorates, but from whom all of the relevant personal information has been collected, and $135, a discounted rate, for sperm from men who became donors before extensive information was gathered.[40] Given the range of prices by agency, there are two ways that men could have higher sperm prices. First, by having the broad characteristics that bring a higher price within an agency or, second, to sell sperm to an agency whose higher prices reflect a higher overall quality of donor. Without individual variation in prices, it can be difficult to tell which characteristics are desirable. So we use an alternative way to determine the desirability of a donor's sperm. Many sperm agencies publicize whether a man's sperm has already been sold (sometimes listed as resulting in a pregnancy). We will use this selection as a proxy for desirability and assess which characteristics make it more likely that a man's sperm was chosen.

It is far too early to arrive at a definitive decision about the determinants of price in these markets. However, we can present an empirical analysis that is illuminative and absolutely preliminary. As noted earlier, the author collected information on 1509 sperm donors from over thirty sperm banks that advertised on the Internet. From these, 490 had information on a previous pregnancy or selection. Not too surprisingly (given that sperm banks do not individually price sperm) there is almost no characteristic that is associated with a higher or lower sperm price (See Table 3). The regression on prices shows that only a graduate education ($19.83 more than mere college) and height ($1.91 per inch) are associated with increased prices. This is not too surprising since one sperm bank specifically prices by education. Surprisingly (assuming selection is a good proxy for desirability), however, only race influences selection. No characteristic explains differences in selection probabilities except for being Asian or being of

[40] These prices are for IUI specimens and are correct as of January, 2004.

multiracial heritage (both negative at 5 per cent level of significance).[41] What does this tell us? Racial aspects of the market are unclear. White, African American, Latinos, and Native American men are not selected at differential rates. Earlier it was noted that the income distribution may play a large role in determining the tastes of demanders. It may well be that there is racial matching for sperm (people choose sperm from individuals of their own identified race) and that there are fewer demanders of Asian or multiracial heritage (note that this could be an income effect, or a genetic effect (a lower proportion of Asian men, for example, may be infertile). It also raises the possibility, however, that the characteristics of the male do not influence desirability (or that the filters of the various agencies are strong enough to weed out any obviously undesirable characteristics, and eye and hair color, weight, height, and so on are secondary in decision making).

Women set their own compensation request at egg donor agencies. This is known as an offer price. We cannot tell how far the final price differs from the offer price because this information is not made public by agencies. In this data set of over 2000 egg donors, the average compensation request is $5145, the minimum is $1800 and the maximum is $20,000. Women's eggs cost much more than men's sperm almost certainly because retrieval is more costly and risky. But, of course, we cannot say for sure whether a woman will receive her compensation

[41] This data set may contain biases which have yet to be understood. The range of information varied by agency so the selection of agencies may influence the results. Age may be a positive factor in selection, as may grades and college scores. Many firms did not advertise the same information. The chosen regression was the one with the largest sample size for men and women with the most comparable variables so that characteristics could be compared. There were not enough egg donors with information about race to construct a comparable regression. When the sperm donors' regressions were run without race, nothing was significant—indicating that race did not substitute for other characteristics. Since sperm prices do not vary by individual, the regression should be considered illustrative only. Finally, there are not reported standard errors in the selection equation because the marginals (changes in the log odds) are reported.

request. Therefore, the same technique is used for egg donors as with sperm donors (having been already selected is a proxy for desirability).

Table 4 shows the same regression results for women as for men. But the results for women are remarkably different. First, education plays the critical role in the compensation request and in the probability of being currently matched. A college education is worth $448 more than a high school education and a graduate education is worth $2365 more than a high school education (about 15 per cent of egg donors only have a high school education). Further, physical characteristics matter for women. Every extra inch of height brings an additional $88 while every extra pound reduces compensation by $15. Selection characteristics are similar: A graduate education almost quadruples the odds of being currently matched, as does height. Weight reduces the probability of a match.

Why do a woman's characteristics appear to relate so strongly to price while men's do not? A good part of this result is an artifact of the way that prices are set in the two different markets. But why is there no individual pricing for men, but women set their own price? One reason surely is that removing eggs is a more risky procedure than removing sperm. At the same time, both egg and sperm are just a set of genetic components. Outside of a differential for risk, there is no obvious reason why they are priced differently. While it may be empowering for women to set their own compensation price, it begs the question of the determinants they use to calculate that price. Almost certainly education plays a dual role in egg pricing. It enhances the desirability of a woman's eggs because it proxies intelligence. It also is correlated with the value of a donor's time (her opportunity cost). It is curious that for men, race appears to influence desirability, but for women, physical characteristics outside of race play a role in the price that a

woman sets. Women may be more culturally sensitive to the value of looks. Selection, as a proxy for desirability, shows almost exactly the same results as the price regressions, suggesting that there are some fundamentally sound cultural reasons for setting such price differences.

V. Ethics in Assisted Reproduction

The previous sections of the chapter function in the realm of positive economics ('how does it work?'), but when we look at ethics, we move into the realm of normative economics (how should it work?). We encountered a similar situation in Chapter 11 when Samuel Cameron discussed the Economics of Pornography. Indeed, like the case of pornography, ethical arguments about assisted reproduction are rich and varied. There are hundreds, if not thousands, of articles on the big and minute ethical questions raised by AR. Most arguments have to do with the proper scope of the market. Where should the market stop? First and foremost, people argue that there should be no price put on a human being's body. The argument is against commodification of the person because this way we lose our value as humans. The Human Fertilization and Embryology Authority (HFEA, 1998) claimed just that when recommending that egg donation should be a gift and that payments should be eliminated. Radin (1996), like many, argues that we ought to be inalienable to the market and that commodification is harmful to personhood. Thus, there are "contested commodities". Even the language of commodification as part of the discourse is itself harmful. Surrogacy has provided fodder for a number of discussions. Anderson (1990:75) says that surrogacy is women's labour, that is, the labour of carrying a baby to term, and if treated as a commodity is degraded. Further, children are reduced to commodities. Is assisted reproduction tantamount to selling babies? Hirschman (1991:387)

says that AR markets are "centered around the production and acquisition of babies—babies in the form of component sperm and eggs, babies in the form of fresh or frozen embryos,…and babies as full term living infants". She argues that, in the end, although such markets are "morally troublesome", they can be "ethically construed as positive if they serve the larger sacred goal of creating families" . Ethical questions often confront religious questions. What makes a family? Who can make a family? What makes a mother or a father?

Summary

In the end, these ethical questions drive us to a better understanding of ourselves. This debate is crucial to help us determine what to do about market regulations, laws about the permissibility of some markets, and the modes of market organization. At the same time, while we argue ethics, the markets go on, fed by technology, need, altruism and greed. We have outlined here some of the critical features of markets in assisted reproduction. We know that the potential size of the markets is enormous and that the actual size is growing rapidly. We know that there are different pricing structures in eqq, surrogacy, and sperm markets. We know that individual prices in the egg market vary markedly by the characteristics of the donor. We know that various forms of insurance have arisen to reduce the impact of risk in the markets. As relatively new markets, we can argue that they follow the basic constructs of economic theory. We don't know why men don't set their own price for sperm. We don't know why physical characteristics are important for egg donor's desirability but not sperm donor's (in either case, 50 per cent of the DNA is contributed by the donor). We don't have a sense of the changes in social welfare that have emerged from different market organizations. In sum, we do not yet know many of the details of how these markets function, nor what stable equilibria look like in the markets for sperm, eggs, and surrogacy. Understanding the positive and normative issues of

markets of today can help us figure out the social and economic consequences of the markets that are coming and the ethical arguments that may support or fall against the development of those markets. Genetic engineering and "designer babies" are only a step away. As Francis Fukuyama (2002:82-83) states, "even if genetic engineering on a species level remains twenty-five, fifty, or one hundred years away, it is by far the most consequential of all future developments in biotechnology. The reason is that human nature is fundamental to our notions of justice, morality, and the good life, and all of these will undergo change if this technology becomes widespread."

Figure 1: A "market" for AR contracts with donation only

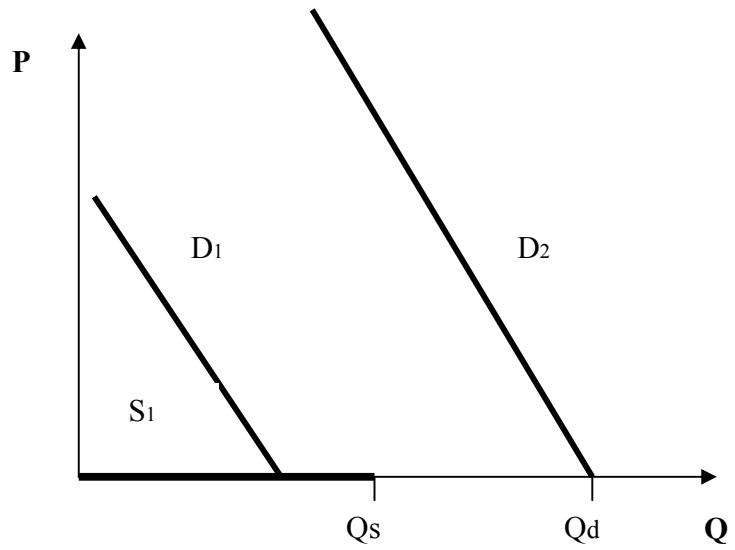

Figure 2: A market for AR contracts with a legal positive price

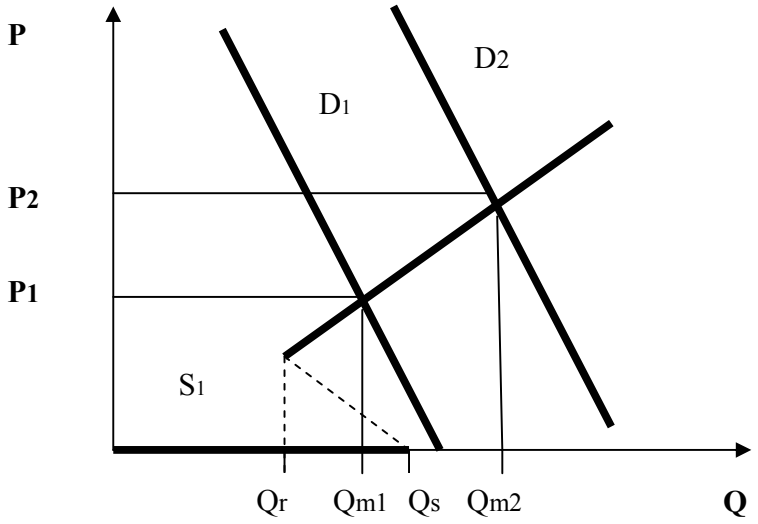

Table 1
Table of Assisted Reproduction Services provided in Europe[α]

Country	**IVF**	**DI (Sperm)**	**DI (egg)**	**DI (embryo)**	**Surrogacy**
Austria	Yes	No[ξ]	No[ξ]	No[ξ]	No
Germany	Yes	Yes	No	No	No
Denmark	Yes	Yes	Yes	No	No[Ψ]
France	Yes	Yes	Yes	Yes	No
Norway	Yes	Yes	Yes	No	No
Sweden	Yes	No	No	No	No
Netherlands	Yes	Yes	Yes	Yes	Yes
Spain	Yes	Yes	Yes	Yes	Yes
United Kingdom	Yes	Yes	Yes	Yes	Yes[λ]
Greece	Yes	Yes	Yes	Yes	Yes
Hungary	Yes	Yes	Yes	Yes	Yes
Italy	Yes	Yes	Yes	Yes	Yes
Poland	Yes	Yes	Yes	Yes	Yes
United States	Yes*	Yes*	Yes*	Yes*	Yes*

[α] Source: http://www.gov.gg/childrenboard/pdf/AssistedReproduction.pdf
[ξ] All forms of assisted conception with donated gametes are prohibited with the exception of semen donation in IVF.
* Legal in at least some U.S. states.

[Ψ] Surrogacy in itself is not forbidden only its procurement. Also, surrogacy contracts are not forbidden but considered legally invalid.
[λ] Surrogacy is accepted but specific regulation prohibits commercialization.

Table 2 The Probability of a Live Birth in any cycle (AR T Statistics from CDC, 2003)		
ART Procedures	**Fresh eggs**	**Frozen eggs**
Non-donor eggs	25.4%	19.5%*
Donor eggs**	43.3%	23.5%
Gestational Carriers		
Non-donor eggs	36.8%	22.6%
Donor eggs	46.1%	32.8%

The pregnancy rate per cycle of couples with proven past fertility is approximately 20% (Society for Assisted Reproductive Technology (SART), A patient's guide to assisted reproductive technologies, page 7. http://www.sart.org/TextPatients.htm.).

* per thaw

** per transfer

Table 3 Sperm donor Compensation and Selection Effect of Individual Characteristics		
	Compensation ($)	**Selection**
Height	**1.91*** (0.82)	0.985
Weight	-0.09 (0.07)	0.999
Graduate Education	**19.83*** (3.74)	1.283
Eye Color	3.48 (4.95)	1.631
brown/black	4.37 (4.87)	1.538
green		
Hair Color	-2.45 (5.42)	0.780
brown/black	-1.61 (13.16)	1.000
red		
Race Latino	-2.94 (11.65)	1.268
Asian	2.89 (6.14)	1.416
Black	-2.44 (8.78)	**0.474***
Mixed	16.07 (8.75)	**0.358***
n	879	438

Standard errors in parentheses. Regression includes a constant: The omitted characteristics are a white, blue eyed, blond, with a high school diploma. The compensation regression is OLS, and the selection regression is a binomial logit (the reported coefficients are the change in the log odds associated with that variable—a value of 1 means no change, greater (less) than one means increased (decreased) probability.

*significant at 5%

Table 4 Egg donor Compensation and Selection Effect of Individual Characteristics		
	Compensation	**Selection**
Height	**88.43*** (34.01)	**1.131***
Weight	**-14.69*** (5.08)	**0.967***
Education		
College	**448.26*** (223.35)	1.499
Graduate School	**2384.87*** (322.68)	**4.740***
Eye Color		
Brown/black	-263.28 (225.08)	0.669
green	-285.76 (222.70)	0.931
Hair Color		
dark	-217.39 (212.22)	1.170
Race		
N/A		
n	693	296

Standard errors in parentheses. Regression includes a constant: The omitted characteristics are a white, blue eyed, blond, with a high school diploma. The compensation regression is OLS, and the selection regression is a binomial logit (the reported coefficients are the change in the log odds associated with that variable—a value of 1 means no change, greater (less) than one means increased (decreased) probability.
** significant at 5%

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