Modeling beauty

Francisco M. Torralba

University of Chicago

Department of Economics

June 5th 2004

Beauty is one dimension of an individual's human capital: This paper is a theoretical analysis of the optimal determination of investments in beauty capital. After a review of the literature on this topic, the paper takes on three questions regarding the optimal level of beauty in the labor market and in the marriage market. The first model considers beauty over the life-cycle in a world where beauty and other forms of human capital jointly determine an individual's wage level. The second model analyzes the situation where beauty is not productive and where individuals derive utility from their beauty relative their group's as well as, possibly, from their absolute level of beauty. Finally, the third model considers a marriage market where the female's beauty matters in an indirect way, because more beautiful females are matched to 'better' males.

1 Introduction

The beauty industry is large and growing rapidly. According to a study by Goldman Sachs, as reported by The Economist (2003), its world revenues amount to $160 billion a year. Even after eliminating the share of this expenditure that is aimed at improving the consumers' health, rather than beauty, the size of the beauty industry is probably very large. As an example, the same source informs that the skin care sub-industry is worth $24 billion; make-up, $18 billion; hair-care products, $38 billion; and perfumes, $15 billion. Moreover, this industry is growing at up to a 7% per year. The cosmetic surgery industry, which was not included in the figures above, is already a $20 billion business. In the US, the number of cosmetic procedures increased by over a 220% between 1997 and 2003 and, as the price of cosmetic surgery drops, it is becoming more and more popular, with over 70% of the customers now earning less than $50,000 a year.

Individuals may care about their physical appearance for various reasons. First, more beautiful individuals may find better partners in the marriage market. Second, physically attractive people may also be more likely to be hired and to have a higher wage, and more likely to promoted than unattractive people. Finally, individuals may derive utility *directly* from their beauty. Beautiful people receive more attention, admiration and respect than other individuals, because most individuals derive pleasure from interacting with beautiful people. (Etcoff (1999), chapter 3). However, the same is true for famous economists or opera singers, regardless of whether they are beautiful or not. I would say that what individuals are actually concerned about is their status, and that beauty is one factor in its determination. The distinction is important because individuals may make up for their lack of physical attractiveness with investments in education or in the development of desirable personal characteristics to improve their social status.

Beauty should be regarded as just one more dimension of an individual's human capital, like education, experience, ability and health. However, in my opinion there are two aspects that make beauty different from other forms of human capital. The first one is that it declines with age, and it does so at a much faster pace than physical strength or health; physical beauty typically peaks by the age of 35, whereas individuals in developed countries generally remain in good health until their fifties or sixties. The other characteristic is that relative beauty is likely to matter more than absolute beauty. Quoting Barro (2002), "if everyone were suddenly to become more attractive, as judged by current standards, would we all be happier? Or would we adjust the benchmark correspondingly upward and therefore be no happier? Height is an example of a trait that is mainly relative; little would be accomplished if everyone became one inch taller", and then he concludes that if it is *only* relative beauty what matters, any investment in beauty capital would be socially wasteful. If only relative beauty mattered, two different societies with the same distribution of beauty among its members but with different levels of average beauty would enjoy different levels of social welfare: the society with a *higher* level of average beauty would have a *lower* welfare because it would have fewer resources left over for consumption.

Barro's statement seems to imply that excessive beauty will arise if individuals derive utility from beautiful directly. This would be a classic externality. However, would that still be the case when beauty is instrumental, in the sense that it affects utility exclusively through the allocation of consumption? What if beauty is productive and there is a market for beauty? An example of purely instrumental beauty is a matching model for the labor market, where employers select their employees from a pool of applicants based on their physical attractiveness. In equilibrium the most beautiful people would be matched to the better-paying jobs, but the average level of attractiveness of the employees is irrelevant, because in equilibrium all of them would get a job. A similar thing would happen in the marriage market.

An objection to the economic analysis of beauty is that the perception of what is beautiful varies substantially over time and across societies. I claim that this variation is irrelevant. The fact that what is considered beautiful varies across societies is of little relevance for the behavior of individuals within a society, and with regard to changes over time the key is that beauty standards change sufficiently slowly over time within a society, so that they are constant over the life of an individual or make it possible for individuals to change their looks during the course of their lives. Finally, research in sociology has shown, moreover, that there is substantial agreement among heterogeneous individuals on beauty rankings.

The rest of the paper proceeds as follows: in part 2, I present the empirical evidence of the effect of looks on labor and outcomes; in part 3 I take on the question of how should beauty and investments in beauty change over the lifetime of a person, if beauty is productive in the labor market and there are other forms of human capital; in part 4 I investigate the implications of a model where relative, as well as (or rather than) absolute beauty matters, and where beauty is not productive but increases utility; part 5 presents a matching model for the marriage market where men and women are matched according to their beauty and their human capital; in part 6 I make some concluding remarks.

2 Empirical evidence

There is a relatively large literature on the economics of discrimination in the labor market, . Discrimination based on beauty has not received much attention. Most surveys on labor market outcomes do not collect information on the individual's looks, in part probably because self-reported beauty and the opinion of the interviewer might be seriously biased. In spite of these difficulties, a small group of empirical studies has been conducted in the 1990s, of which I present a brief summary.

The first empirical study I could find on the effect of personal appearance on labor outcomes is Register and Williams (1990). They defined an obese person as someone who is at least a 20% above the ideal body weight, and they showed that, controlling for some social and demographic characteristics, wages for obese people were a 5% and a 12% (for males and females, respectively) lower than for non-obese individuals. Another potentially serious problem of their paper is that it does not account for the possible endogeneity problem, namely that low earnings might induce some changes in eating and in other habits which in turn cause an obesity condition.

Averett and Korenman (1996) provided some new evidence of the relationship between obesity and performance in the labor market, as well as in the marriage market. Using the body mass index (BMI) as a measure of an individual's obesity, their main finding is that obese women have lower family incomes (the result for men was mixed). They showed, however, that differences in marriage probabilities and in the husband's earnings account for 50-95% of the family income differentials. They explicitly addressed the endogeneity problem by using the BMI of the individual at a younger age as well as the current BMI. They also showed that obese black women do not suffer any economic penalty relative to non-obese black women.

Hamermesh and Biddle (1994) used surveys where individuals' beauty is evaluated by the interviewer to show that there exists a wage premium for good looks, and that the premium is larger for males. That premium is independent of occupation, but better-looking people are sorted into occupations where beauty is likely to be more productive, although the evidence about sorting was weak. Also, unattractive females are less likely to be employed. Regarding the marriage market, they couldn't find any evidence of the effect of beauty on the likelihood to be married, but they did find that homely women tend to marry men with less of human capital than attractive women do; no such evidence was found for men.

Bosman et al. (1997) looked at the effect of beauty on the performance of managers. Using a sample of advertising firms from the Netherlands, they found that firms with more attractive executives have more revenues, and that this effect is larger than the likely effect of beauty on the earnings of the executives. They use this result to conclude that beauty creates firm-specific investments, and that both the firm and the executive receive a share of the return to those investments.

Biddle and Hamermersh (1998) used a longitudinal sample of attorneys who graduated from one law school, whose beauty was evaluated by a panel of adults by looking at their matriculation photographs, to show the impact of good looks on their careers as lawyers. In particular, they showed that attorneys in the private sector were better looking that those in the public sector which, according to the authors, might be due to the fact that customers select attractive attorneys if they have the option to do so. Also, the probability of attaining an early partnership increased with beauty. They also found that lawyers in areas where personal interaction is more important for the outcome (such as litigation) are more attractive than lawyers in other areas.

Hamermesh, Meng and Zhang (2002) used a survey that included data of expenditures on beauty-related items and provided some evidence that beauty raises women's and men's earnings, and that spending on clothing and cosmetics has a positive but decreasing impact on beauty; however, they estimated that only about a 10% of such expenditures contributes to higher earnings, and concluded that the rest is part of 'consumption'.

Hamermesh and Parker (2003) look at the effect of beauty on the teachers' performance. They used a sample of instructional ratings by undergraduate students at the University of Texas at Austin and the pictures of the teachers, whose beauty was evaluated by a panel of six persons. They found that more beautiful instructors received higher ratings. The effect remained even after controlling for departments and for courses, and was higher for men than for women. As the authors recognized, this does not prove that students learn less from ugly professors (i.e. that beauty is productive): it could just be that students treat good looking instructors differently and that their higher ratings is evidence of discrimination.

There are several issues that need to be resolved in the empirical literature on beauty. The first one is the measurement of beauty. Researchers typically use panels of a small number of persons who independently evaluate the pictures of the subjects of interest. The panel's representativeness of the relevant population is never guaranteed and, in case of disagreement among the members of the panel, the procedure of simply averaging their ratings is, at best, somewhat arbitrary. The second issue is that beauty may be a proxy for an unobservable characteristic that affects positively the performance of the indiviual and that is not perfectly correlated with beauty. One might argue that better looking people are more self-confident and this makes them better lawyers or professors, and that beauty does not perfectly determine someone's self-confidece. To the extent that those unobservable characteristics are positively (negatively) correlated with beauty, the effect of beauty is overstated (understated). Perhaps the most important issue is that it is not possible to determine whether better outcomes for beautiful people are due to employer discrimination or to customer discrimination. In the latter case, it is not clear if it is due to the fact that beauty is productive (in the sense of contributing to a better output) or non-productive, in which case discrimination would happen simply beause customers derive utility from interacting with beautiful people.

3 A model of career choice and beauty capital over the life cycle

We all know that beauty is an ephemeral virtue. It does not dissapear abruptly but does decay, in general, shortly after reaching adulthood. We also know that (fortunately) beauty is not the only dimension of human capital that determines our performance in life, either in the professional or in the social arena. Other characteristics, such as education, health and character are equally if not more important than beauty. Faced with limited resources and with comparative advantage in the development of some forms of human capital over some others, rational individuals will substitute among the several dimensions of human capital. (From now on, for convenience, I will call human capital any form of human capital other than beauty, although the reader is urged to keep in mind that beauty and non-beauty capital are both dimensions of an individual's human capital.)

In this section of the paper I will try to answer the question of how much resources should individuals invest in beauty and when those investments should be made. To simplify the analysis, I will assume that human capital is a combination of on-the-job training, expertise, ability and physical and mental fitness, all of which are acquired (or depreciate) as a by-product of working experience and aging.

3.1 Beauty over time in the labor market

Consider the problem of an individual who has completed her invesment in education in a previous stage of her life and who has already chosen a working career. At this point, she will accumulate human capital only through work experience and aging, which lets us express the accumulation of such capital as a mere function of time. The change of beauty capital over time, on the contrary, depends on the individual's genetic composition, α, on the specific investments in beauty made by the individual, i_{bt}, on the depreciation of her beauty capital, δ, and also on her age, according to the following law of motion:

$$\begin{aligned} \dot{B}_t &= \alpha f(i_{bt}, t) - \delta B_t \\ f_1 &> 0, f_2 < 0, f_{12} < 0 \end{aligned} \tag{1}$$

This functional form is embedding the assumption that beauty depreciates at the same rate at all ages, that investments in beauty increase the stock of beauty of capital and that the passage of time, for a given level of investment, decreases it. Also, the negative cross derivative implies that the return to investments in beauty declines over time. Finally, a better genetic endowment affects an individual's beauty through a higher return to investments in beauty, and it does so in a proportional way.

In order to further simplify the analysis, and without much loss of generality, I will assume the following functional form for $f(i_{bt}, t)$:

$$f(i_{bt}, t) = e^{-\theta t} i_{bt} \tag{2}$$

so the law of motion of beauty capital is

$$\dot{B}_t = \alpha e^{-\theta t} i_{bt} - \delta B_t \tag{3}$$

Human capital evolves according to

$$H_t = H_0 e^{\kappa t} \tag{4}$$

so that its instantaneous change is determined by

$$\dot{H}_t = \kappa H_t \tag{5}$$

H_0 is given exogenously and captures the level and quality of schooling, ability, and health and physical conditions inherited in previous stages of the individual's life.

For a given occupation, I will assume that both beauty and other forms of human capital increase the individual's productivity, but they do not necessarily have the same marginal effect. Workers participate in a perfectly competitive labor market, where the wage is equal to marginal productivity. The wage depends on B and H according to the reduced form:

$$w_t = w(B_t, H_t) \tag{6}$$

with $w_B > 0, w_H > 0$, and $w_{BB} \leq 0$.

Notice that, throughout this section of the paper, I am assuming that beauty is measured in absolute terms, not relative to the beauty in the individual's age group, or relative to any single person or group of persons for that matter.

Finally, the individual is subject to the budget constraint

$$c_t + pi_{bt} = w_t \tag{7}$$

where p is the price of the beauty investment goods and her objective is to maximize her lifetime utility, from age 0 (the age at which she takes the job) to age n (n can be interpreted as either the retirement age or the age at death: this distinction does not make any difference in a model where beauty affects only labor income, not utility directly):

$$U = \int_0^n e^{-\rho t} u(c_t)\, dt \tag{8}$$

The individual's problem is thus to maximize (6) subject to (1), (2), (4), (5) and initial conditions B_0 and H_0, by choosing paths for c_t and B_t. The Hamiltonian function that represents this problem can be written as

$$S = e^{-\rho t} u(c) + v \left[\alpha e^{-\theta t} \left(\frac{1}{p} (w(B,H) - c) \right) - \delta B \right]$$

The first order conditions for this problem are

$$\frac{\delta S}{\delta c} = 0 \Leftrightarrow e^{-\rho t} u'(c) = \frac{1}{p} v \alpha e^{-\theta t} \tag{9}$$

$$\dot{v} = -\left[\frac{\alpha}{p} e^{-\theta t} w_B(B, H) - \delta\right] v \tag{10}$$

And the transversality condition

$$B_n e^{-\rho n} \geq 0 \tag{11}$$

Now I assume that the utility function takes the CRRA functional form

$$u(c) = \frac{c^{1-\sigma} - 1}{1 - \sigma}$$

with $\sigma > 0$. Combining the first order conditions we obtain that the optimal growth rate of consumption is determined by

$$\frac{\dot{c}_t}{c_t} = \frac{1}{p_t} \frac{\alpha}{\sigma} e^{-\theta t} w_B(B_t, H_t) - \frac{1}{\sigma}\left(\rho + \delta - \theta - \frac{\dot{p}_t}{p_t}\right) \tag{12}$$

As expected, the change in consumption will depend positively on the individual's genetic fitness, α, and in the marginal product of beauty, w_B; it will depend negatively on the rate of decay of the productivity of investments in beauty, θ, on the depreciation rate of human capital, δ, and on the rate of time preference, ρ.

In order to be able to make sharper predictions, I will solve for the steady state of consumption and characterize the evolution of beauty and of investments in beauty as a function of the givens of the problem:

$$\frac{\dot{c}_t}{c_t} = 0 \Leftrightarrow e^{-\theta t} w_B(B_t, H_t) = \frac{p_t}{\alpha}\left(\rho + \delta - \theta - \frac{\dot{p}_t}{p_t}\right) \tag{13}$$

Taking logarithms and time derivatives in the last equation, and assuming that the growth rate of the price of beauty goods is constant:

$$-\theta + \frac{w_{BB}\dot{B} + w_{BH}\dot{H}}{w_B} = \frac{\dot{p}}{p}$$

or

$$-\frac{w_{BB}}{w_B}\dot{B} = \frac{w_{BH}}{w_B}\kappa H - \theta - \frac{\dot{p}}{p} \tag{14}$$

An interesting feature of this solution is that the *growth rate* of beauty depends on neither the individual's genetic endowment nor in the discount rates ρ and θ nor in the depreciation rate of beauty capital. (The *level* of beauty will depend on the values of those parameters, in general.) The last equation shows that the sign of the growth rate of beauty capital depends on the complementarity or substitutability between B and H.

Whether beauty increases or decreases the returns to human capital is not obvious. The empirical evidence presented above is not very helpful because it points to a positive effect of beauty on wages, *conditional* on a level of human capital. I would say that, to large extent, the effect of beauty on the marginal return to human capital depends on the type of professional career of the individual. Beauty is likely to increase the returns to talent for salespeople and litigation lawyers, for instance; on the other hand, singers, actors, athletes and even politicians often make up for their lack of top-notch talent with attractive faces and bodies. The complementarity or substitutability of beauty and human capital may change even during the course of an individual's career, if the qualitative nature of his job changes.

With regard to the change of human capital over time, in a scenario where all the increase in human capital comes from accumulation of experience and aging, it is expected to be positive in early stages of the worker's life, with this rate decreasing with age and eventually becoming possibly negative, due to declines in health and in general ability to perform his tasks.

Based on equation (#), and assuming that the price of beauty goods is constant over time, the following table summarizes the sign of the growth rate of an individual's beauty capital, depending on the sign of the growth rate of human capital and of the cross derivative of the wage function:

	$w_{BH} > 0$	$w_{BH} \leq 0$
$\kappa > 0$	$+/-$	$-$
$\kappa < 0$	$-$	$+/-$

Example 1 *Consider the following functional forms for the wage rate:* $w_t = B_t^{\gamma} H_t^{1-\gamma}$ *and* $w_t = (aB_t + H_t)^b$. *The growth rates of beauty capital are given by* $\frac{\dot{B}_t}{B_t} = \frac{\dot{H}_t}{H_t} - \frac{\theta}{1-\gamma}$ *and* $\frac{\dot{B}_t}{B_t} = -\frac{\dot{H}_t}{B_t a} - \frac{\theta(aB_t+H_t)}{B_t a(1-b)}$. *For the case where beauty and human capital are complements, beauty capital grows with human capital along an optimal path, but beauty capital will grow only if aging does not affect the returns to investments in beauty capital too much. Also, when the share of beauty increases (γ increases) the growth of beauty capital over time decreases, reflecting the fact that the higher the returns to beauty, the earlier invesments in beauty should be made. For the case where beauty and human capital are substitutes, beauty capital will unambiguously fall. Figure 1*

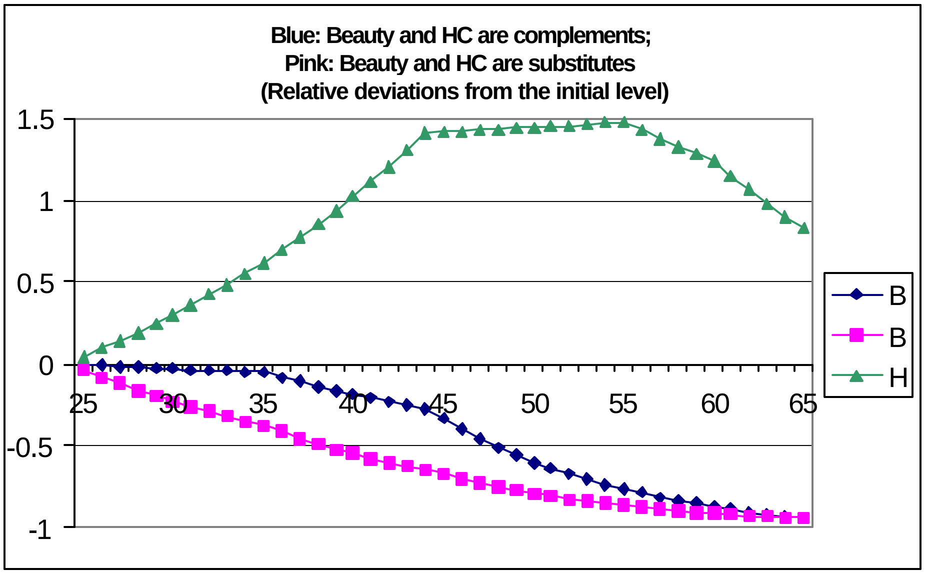

Figure 1:

illustrates a discrete time approximation to the evolution of beauty and human capital over time. (The values of the parameters used to construct that graph are given in the appendix.) Notice how, for a given path of human capital and initial levels of beauty and human capital, the level of beauty capital is higher for the case where beauty and human capital are complements than when they are susbstitutes. The values of the parameters used to construct Figure 1 are $\gamma = 0.2$*,* $B_0 = 1$*,* $H_0 = 5, b = 0.05$*,* $a = 1.53E + 11$ *and*

Age	κ
25-44	0.045
45-55	0.0025
56-60	-0.02
61-65	-0.04

Age	θ
25-35	0.04
36-45	0.06
46-65	0.08

The values of a and b were chosen to equalize the wage rate between the complements and the substitutes case, at the initial levels of beauty and human capital.

4 Is it absolute or relative beauty what matters?

One could argue that what matters is not how beautiful we are in an absolute sense, but relative to those around us. As I mentioned in the introduction, Barro (2002) brought up this question and concluded that there is excess investment in beauty, relative to the socially optimal level. In this section I investigate the validity of this claim when we put relative beauty in the utility function. A motivation for the introduction of concern for relative, rather than absolute, beauty is that the analysis I did in the previous section could be applicable to health with no substantial modification. Just like beauty, achieving a given level of health requires higher and higher investments with age. However, improving the health of everybody would make us more productive, but would making everyone more beautiful make us more productive or happier? Probably not.

4.1 A model of beauty with social interactions

Consider an environment where individual i derives utility from her beauty and from her consumption. The individual does not care about beauty in an absolute sense, but relative to the *average level beauty*. Her utility function is additively separable in those two goods. Specifically, $U(c_i, b_i) = u(c_i) + v\left(\frac{b_i}{B^\psi}\right)$, with $0 \leq \psi \leq 1$. ψ parametrizes the relevance of average beauty for the individual's utility: setting $\psi = 0$ eliminates the social interaction, with $\psi = 1$ only relative beauty matters. Both $u(.)$ and $v(.)$ are increasing and concave in their respective arguments, and $u(.)$ satisfies the Inada conditions, just to ensure that $c > 0$. I will also assume that $v'(x) > -v''(x)x$ for all $x > 0$, for reasons that will become clear later on[1]. Beauty is 'produced' with a linear technology: $b_i = \alpha_0 + \alpha_i z_i$, where z_i is the amount of beauty-enhancing intermediate goods and services purchased by the individual (for example, make-up, haircuts and cosmetic surgery) and $\alpha_i \in [\alpha^{\min}, \alpha^{\max}]$ is an individual-specific parameter that measures the efficiency in the production of beauty, reflecting factors such as genetic endowment. (The inclusion of the base level of beauty α_0 is due to technical reasons. In particular, to have a strictly positive level of beauty even if the the individual does not buy a positive amount of z.)

[1]With this condition we do not lose a great deal of generality but it rules out, in particular, a logarithmic specification for $v(.)$.

The individual's budget constraint is $c_i + pz_i = \hat{y}_i$: p is the price of intermediate beauty goods and we take the price of the consumption good as the numeraire. An indivdual's income $\hat{y}_i$ and her genetic endowment α_i are assumed to be independently distributed. I found it convenient to substitute the beauty production function into the budget constraint and work only with c_i and b_i as choice variables and with $q_i \equiv p/\alpha_i$ as the relevant, individual-specific price of beauty, and so the budget constraint becomes $c_i + q_i b_i = \hat{y}_i + q_i \alpha_0 \equiv y_i$, where y_i is full income. From now on I will drop the individual subscripts, with the understanding that I will be solving for the consumption and beauty of a specific individual.

The problem of an individual who wishes to maximize her utility subject to a price level and an exogeneous income is

$$\max_{c,b} u(c) + v\left(\frac{b}{B^\psi}\right)$$

$$\text{s.t. } c + qb = y$$

The first order conditions of the problem are

$$u'(c) = \lambda \tag{15}$$

$$v'\left(\frac{b}{B^\psi}\right)\frac{1}{B^\psi} \leq \lambda q \tag{16}$$

and the last equation will be satisfied with equality if b is strictly positive. We can obtain some preliminary conclusions from combining these two equations for the case where $b > 0$:

$$\frac{u'(c)}{v'\left(\frac{b}{B^\psi}\right)} = \frac{B^\psi}{q} \tag{17}$$

We learn at least one thing from the first order condition alone: the ratio $\left(\frac{c}{\frac{b}{B^\psi}}\right)$ is increasing in p and decreasing in α, i.e. individuals increase their beauty, relative to their level of consumption, when the market price of beauty products decreases, and individuals with better genetic endowments appear to be more beautiful, relative to their level of consumption. (These two results make use of the concavity of the utility function.)

4.1.1 Comparative statics

We are interested in how individual beauty changes with prices, income, genetic fitness and, above all, beauty in the group they belong to. Using the determinant of the Hessian of this problem

$$D = \begin{vmatrix} 0 & 1 & q \\ 1 & u'' & 0 \\ q & 0 & v''/B^{2\psi} \end{vmatrix} = -q^2u'' - \frac{v''}{B^{2\psi}} > 0 \tag{18}$$

and Cramer's rule we obtain that individual beauty increases with group beauty:

$$\frac{db}{dB} = \frac{\frac{\psi}{B^{1+\psi}}\left[v''\frac{b}{B^{\psi}} + v'\right]}{|D|} > 0 \tag{19}$$

The assumption we made at the beginning of this section guarantees that individual beauty will increase with the average beauty in the group. This is the consequence of including relative beauty rather than absolute beauty as the good of interest in the utility function. Notice that if $\psi = 0$ the social interaction disappears and individual beauty does not depend on group beauty.

Repeating the exercise for α and y yields:

$$\frac{db}{d\alpha} = \frac{db}{dq}\frac{dq}{d\alpha} = -\frac{(qbu'' - \lambda)}{D}\frac{p}{\alpha^2} > 0 \tag{20}$$

$$\frac{db}{dy} = \frac{-u''q}{D} > 0 \tag{21}$$

This confirms our expectation that individuals with better genetic endowments will, in equilibrium, appear to be more beautiful, and that beauty increases with income. In general we cannot say whether the level consumption of intermediate beauty goods, z, increases or decreases with α. The usual forces in this type of comparative statics are at work: on one hand, z increases with α due to the substitution effect (individuals with better genes obtain the highest levels of beauty out of a given level of consumption of beauty intermediate goods); on the other hand z decreases with α due to the 'level' effect (for individuals with better genes, less consumption of beauty intermediate goods is necessary to achieve a certain level of beauty). Whether the substitution or the level effect will prevail is uncertain, and all we can say with all generality is that the effect of α on z will depend on the level of z and on the shape of $v(.)$. Example 2 presents a case where investments in beauty unambiguously increase in α.

4.1.2 Social interactions

The demand function for this good is different from the standard demand function in microeconomics in that it depends on its own average level. This may introduce interesting dynamics where the average level of beauty depends positively in the price of beauty intermediate goods, due to the social interaction, as shown in Becker and Murphy (2000), chapter 9. To see why, consider the expression for the derivative of the average demand for beauty with respect to the price of beauty intermediate goods, dB/dp :

$$\frac{dB}{dp} = \frac{\sum_{i=1}^{N} \frac{1}{\alpha_i} \frac{\delta b_i}{\delta q_i}}{N - \sum_{i=1}^{N} \left(\frac{1}{\alpha_i^2} \right) \frac{\delta b_i}{\delta B}} \tag{22}$$

where N is the number of individuals in the group and I used the definition of $B \equiv \frac{1}{N} \sum_{i=1}^{N} b_i$ and the chain rule $\frac{dB}{dp} = \frac{dB}{dq}\frac{dq}{dp}$. From this expression we learn that the social interaction makes the average demand for beauty less elastic with respect to prices, and that that demand could even have a positive slope (i.e. the average demand for beauty may increase with the price of beauty intermediate goods) if the individual response to an increase in average beauty is positive and 'strong enough'. The effect of an increase in the size of the group, as measured by N, has an ambiguous effect on the price elasticity of average beauty, because it also increases the summation in both the numerator and the denominator.

4.1.3 Efficiency

Intuitively, in a world where only relative beauty matters, the efficient thing to do would be not to spend any resources to improve one's beauty. Consider two societies, A and B. The cumulative distribution of beauty among individuals is exactly the same for both societies. However, society A invests more resources in beauty than B, so individuals in A are on average more beautiful than in B. If the total resources available to both societies are the same, it is clear that society B is better off than A, because their individuals derive the same utility from their beauty as those in A, yet they enjoy a higher level of consumption.

Our model captures the lack of efficiency of the market outcome too. The first order condition of the Pareto problem for individual i (I assume that all individuals receive the same Pareto weight) would be

$$v'\left(\frac{b_i}{B^\psi}\right)\frac{1}{B^\psi} - \psi\frac{b_i}{B^{\psi+1}}\frac{1}{N}v'\left(\frac{b_i}{B^\psi}\right) - \sum_{j\neq i}\psi\frac{b_j}{B^{\psi+1}}\frac{1}{N}v'\left(\frac{b_j}{B^\psi}\right) \leq \mu\frac{p}{\alpha_i} \quad (23)$$

The first term in the left hand side is the same we had in the FOC of the individual's problem; the second term picks up the effect of the individual's contribution to average beauty on herself; the third term represents the effect of the individual's contribution to average beauty on all the other individuals. The absence of the last two terms in the left hand side from the individual's FOC is , externality is algebraically represented by the absence of the last two terms in the individual's FOC.

In order to separate efficiency from distributional issues, consider the case where all individuals are assigned the same genetic endowment: $\alpha_i = \alpha_1$. In that case a social planner would allocate the same level of beauty to each individual: $b^i = B$ for all i. Then the previous equation simplifies to

$$(1-\psi)v'\left(B^{1-\psi}\right)\frac{1}{B^\psi} \leq \mu\frac{p}{\alpha_1} \quad (24)$$

Notce that the efficient level of investments in beauty is zero when $\psi = 1$, i.e. when only relative beauty matters. Then $B = \alpha_0$. Even when $\psi < 1$,from this equation we can see that there will exist a threshold $\bar{\psi}$, such that for all $\psi \in [\bar{\psi}, 1]$, the efficient level of investment in beauty is 0, for all α. That is because the right hand side is strictly positive and because $B > 0$ even when individuals do not invest anything in their beauty, thanks to the introduction of the base level α_0.

Example 2 *Suppose that the utility function takes the form* $U(c,b) = \ln(c) + \left(\frac{b}{B^\psi}\right)^\beta$, *with* $0 < \beta \leq 1$. *Taking the first order condition and after some algebra we obtain an equation that implicitly determines* z *as a function of the parameters of the model*

$$\frac{y - pz}{(\alpha z)^{1-\beta}} = \frac{p}{\alpha\beta}B^{\beta\psi} \quad (25)$$

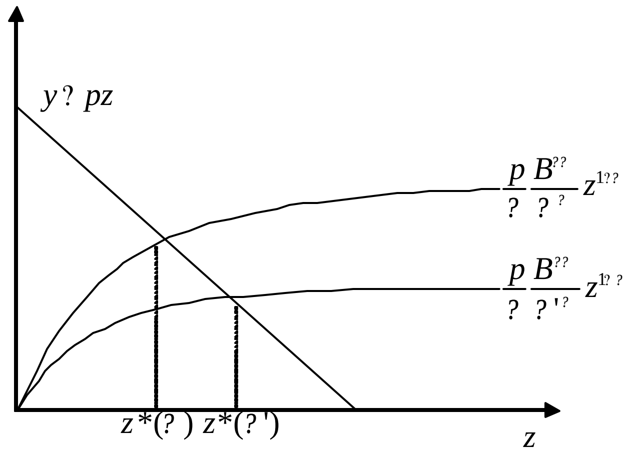

Figure 2:

or

$$y - pz = \frac{p}{\beta}\frac{B^{\beta\psi}}{\alpha^{\beta}}z^{1-\beta} \tag{26}$$

For this case we can prove that z will increase with α. This can be seen most easily with a graph. In figure 2 I plot the left hand side and the right hand side of the last equation separately, for α and for $\alpha' > \alpha$. When α increases, the upward-sloping curve shifts down and the resulting equilibrium z decreases. This experiment is valid as long as the partial effect of an individual's b on B is small enough, as when the relevant population of individuals is large enough.

5 Matching in the marriage market

A concern forr relative beauty (or many other economic variables) does not necessarily require that we include relative beauty as an argument of the utility function. Individuals may care about relative beauty because it is a mean towards the achievement of higher levels of income or consumption in absolute levels. This idea has been exploited in models of matching and tournaments (not regarding beauty, but other attributes according to which individuals can also be sorted, such as skill). In particular, in the topic of mating, Cole, Mailath and Postlewaite (1992) present a model in which agents are concerned about relative wealth because it affects the quality of mates. In their model there is a sequence of generations of males and females with different endowments who match and jointly make a consumption decision. Since the members of a couple share their joint endowment, each individual prefers to marry a wealthy member of the opposite sex. In equilibrium there is positive sorting and, therefore, individuals care about their relative wealth, not by itself as a good in their utility functions, but in an 'instrumental' way: a higher position in the wealth distribution means a wealthier mate and, hence, higher consumption. Becker and Murphy (2000) discuss models of sorting and marriage with and without flexible prices. In their discussion, flexible prices mean that the sharing rule of the marital output is determined by market procedures. An instance of non-market procedures is a marriage with altruism or love, where each individual cares about the utility or the consumption of his or her spouse. I will assume that marriage for love is the only type of marriage possible, because I think it is the most relevant case in most modern societies. (See Becker (1991), chapters 8 and 11, for a discussion of the increasing importance of marriage for love.) I will use some of the analysis in Becker and Murphy (2000) for this section.

An individual's beauty is an important determinant of the quality of his or her partner. Both males and females seek physically attractive partners in the marriage market. In that respect, humans are no different from other animal species. Biologists and anthropologists agree on the fact that the reason why human beings care about the looks of their lovers is that, for most part of the history of the human species, the purpose of finding a partner was reproduction. The physical appearance of a potential partner is important because it signals his or her health, youth and fertility, all of which are characteristics that increase the chances of producing children and/or being able to raise them. There is no question that nowadays we look for other attributes in our partners, and most part of the marriage literature has assumed that a fundamental atribute in mate preferences is income or potential income, and that individuals prefer to marry wealthy mates because they will benefit from their resources when they marry. But the concern for beauty has remained in us as a instinct and conditions, perhaps in an unconscious way, the individuals that we like as partners.

There are gender differences regarding the importance attached to physical attractiveness and financial position. Research in this area has shown that physical attractiveness is more important to men, whereas income or potential income (determined by human capital and profession, for instance) is more important to women. The source of these differences is also biological, as females look for resourceful males who can support them and their offspring, and males seek fertile females who can give them offspring. Again, nowadays marital output has dimensions other than reproduction and financial support, but those have remained as instincts. (The interested reader can find more on the role of beauty in the marriage market and on gender differences about the attributes in mate selection preferences in Etcoff (1999) and Wiederman and Allgeier (1994).) In the analysis that follows I will work with the extreme assumption that only males care about the beauty of their partners, and that both males and females care about the combined income of the couple after they are married.

5.1 Beauty as an exogenous characteristic

In this section of the paper I consider a static environment in which there is a continuum of males and females. Men (women) are endowed with h_i^m (h_j^f) units of human capital and each individual is endowed with $h^0 > 0$ units of human capital, in addition to his or her specific human capital. (Including a minimum level of general human capital is just a technical detail, meant to ensure that every couple has positive consumption.) Women are also endowed with b_k units of beauty. I will assume that males are ordered so that h_i^m is increasing in i. Similarly, h_j^f is increasing in j and b_k is increasing in k. This way males are indexed by i and women are indexed by (j, k). Human capital and beauty are independently and exogenously distributed, taking values from the interval $[0, 1]$. Both males and females participate in the labor market: males earn $w^m h_i^m$ units of the single consumption good, and females earn $w^f h_j^f$, which is independent of their beauty. I will denote the combined income of the couple formed by male i and female j by $Z_{ij}(h_i^m, h_j^f) \equiv z^0 + w^m h_i^m + w^f h_j^f$, and $z^0 \equiv (w^m + w^f)h^0$.

After they marry, I will assume that female (j, k)'s utility is

$$U_j^f(c_i, c_j) = u^f(c_j) + u^f(c_i) \tag{27}$$

and that the male i's utility is

$$U_i^m(c_i, c_j, b_j) = u^m(c_i) + u^m(c_j) + b_k \tag{28}$$

This corresponds to the case where individuals marry only if they are in love and therefore they are altruistic towards each other. With these preferences, regardless of the differences between the incomes of man and woman and the differences between the u^f and u^m functions, each partner will receive an equal share of their combined income, through transfers from the wealthier partner to the poorer one. That is, $c_i = c_j = \frac{1}{2}Z_{ij}$, and then the utility takes the values $U^{f*} = 2u^f(\frac{1}{2}Z_{ij})$ and $U^{m*} = 2u^m(\frac{1}{2}Z_{ij}) + b_k$. Moreover, only the man derives utility from the beauty of his partner, and this is a simplification that reflects the gender differences in preferences over mates described above.

Matching is voluntary and there are no information asymmetries. For a given level of human capital and beauty of a female, I will denote the relationship between an individual female's beauty and human capital and her husband's human capital by the matching function $m(h_j^f, b_k)$, which indicates the human capital of the man who will marry woman (j,k). (Notice that since men are ordered by h_i^m, $m(h_j^f, b_k)$ actually maps the pairs (j,k) on i.) In equilibrium there is no couple of individuals $(i,(j,k))$ not married to each other, who could marry and make each other better off.

An *equilibrium sorting* is a matching function $m : [0,1] \times [0,1] \to [0,1]$ such that

$$2u^f\left(\frac{1}{2}Z_{ij}(\hat{h}_i^m, h_j^f)\right) \geq 2u^f\left(\frac{1}{2}Z_{ij}(h_i^m, h_j^f)\right) \;\; \forall (j,k) \tag{29}$$

and

$$2u^m\left(\frac{1}{2}Z_{ij}(h_i^m, \hat{h}_j^f)\right) + \hat{b}_k \geq 2u^m\left(\frac{1}{2}Z_{ij}(h_i^m, h_j^f)\right) + b_k \;\; \forall i \tag{30}$$

where $\hat{h}_i^m = m(h_j^f, b_k)$ and $(\hat{h}_j^f, \hat{b}_k) = m^{-1}(h_i^m)$.

The fact that males and females differ in their preferences over mates prevents strictly positive sorting. Women desire to be matched with a mate with as much human capital as possible, but men face a trade-off between beauty and human capital: a physically unattractive woman with high human capital may be preferred to a poor but beautiful lady, and vice versa. For the same reason, there may be more than one male who can be matched to a given female in equilibrium. In other words, there may be multiplicity of equilibria.

In the particular case where the marginal utility of consumption is low (high) enough for high (low) levels of consumption, we would find positive sorting between beauty (female human capital) and male human capital at high (low) levels of human capital for the male. (This can easily proved if we assume that $\lim_{c \to \infty} u'(c) = 0$, $\lim_{c \to 0} u'(c) = \infty$ and that $u(.)$ is continuous.) This is because at low levels of marginal utility, the woman's income becomes irrelevant for the male, relative to her beauty, and vice versa, because beauty enters the utility function linearly but consumption does not. [2] For intermediate levels, there might be no sorting in any single variable. What we can say for sure is that, conditional on a level of beauty, there will be positive sorting in human capital and, conditional on a level of female human capital, there will be positive sorting between male human capital and beauty.

5.2 Investments in beauty capital

In a paragraph above I discussed how males prefer physically attractive females because beauty is a signal of more fundamental characteristics such as health, youth and fertility. In the model presented above, the signal is given and fixed. Women cannot do anything to alter their beauty. Suppose now that it is possible to invest in one's beauty capital. A female's invesment in beauty should be determined by her productivity at increasing beauty as well as by the resources available to her. Once beauty can be altered it will reflect differences in the the ability to increase beauty and in income, as well as in the fundamental characteristics that men care about. As long as beauty carries some information about the quality of the female, males will continue to use it as a selection criterion of females. In this subsection I develop a model where women invest some of their income in their beauty capital in order to signal their high value as female.

Now woman (j, k) spends pz_k units of the consumption good to generate a level of beauty b_k given by $b_k = \alpha_k f(z_k)$. The parameter $\alpha_k \in [0, 1]$, is exogenously distributed. The function $f(.)$ is strictly increasing and concave. The interpretation of $f(.)$ and α is the same I gave in section 2 of this paper. We keep the assumption that individuals marry for love and hence they are

[2] The scenario where men with very high human capital base their selection of mate solely on beauty seems to be implausible, however. Concerns about status, for instance, may introduce convexities in the utility function that make it desirable to find a wealthy partner, especially when the male himself is wealthy. (See Becker and Murphy (2000), chapter 8, and Becker, Murphy and Werning (2000), as examples of research in the literature on concerns for status.)

altruistic after they are matched to a partner. So now a woman's problem is

$$\max_{z_k} 2u^f \left(\frac{1}{2}(Z(h_i^m, h_j^f) - pz_k)\right) \tag{31}$$

subject to

$$h_i = m(h_j^f, b_k) \tag{32}$$

$$b_k = \alpha_k f(z_k) \tag{33}$$

$$\frac{1}{2}Z(h_i^m, h_j^f) - pz_k \geq 0 \tag{34}$$

$$z_k \geq 0 \tag{35}$$

Notice that, since men altruistic once they marry, husband and wife will share the expenditures in beauty that she made before they got married.

The first order condition implies

$$w^m \alpha_k f'(z_k) \frac{dm(h_k^f, \alpha_k f(z_k))}{db_k} \leq p \tag{36}$$

and this equation will hold with equality if $z_k > 0$.

For a constant level of the derivative of the matching function, if $z_k > 0$ the first order condition reveals that z_k is strictly increasing in α_k, due to the concavity of $f(.)$. The concern for relative beauty, reflected by m' in the first order condition, leads to an increase in the investment in beauty capital. When m' is large, there is an incentive to invest a lot in beauty, because a marginal increase in the woman's beauty has a big impact on the quality of the match and, hence, on the level of the female's consumption. The effect of a high α_j is similar to that of m', but it also has an indirect effect on z_j, through its effect on m'.

In this model it is still uncertain whether there will positive sorting in any of the female's attributes. That is because α_k and h_k^f are independently distributed and therefore h_k^f and b_k are not perfectly correlated, although there is more correlation than in the previous subsection because women with higher h_k^f can spend more on beauty goods. If α_k were constant then there would be a perfect correlation between h_j^f and b_k and positive sorting: $j = k$ for all women and $m(j) = b^{-1}(b_j) = h^{f-1}(h_j) = h_j^m$. All the females with human capital below h_j^f also have beauty below b_j, so the jth woman is matched to the jth man. In this case m is the cumulative distribution of beauty, and a high dispersion of beauty implies a low m', and vice versa.

Cole, Mailath and Postlewaite (1995) present a one-dimensional model of matching. Males have an exogenously given good that enters marital output, whereas women have an exogenously given productivity level, and choose how much to work in order to determine their level of production of the female good. This good also enters the marital output. In this case there is positive sorting between the level of the male's good and the female's productivity level. Our model would yield a parallel result if, for instance, all females had the same level of human capital.

6 Summary

The models presented above have explored the issues that in my opinion make beauty different from other forms of human capital. These are: a) aging has a substantial effect on how beautiful individuals look; b) beauty is a good to be consumed in a social context and how beautiful other people are has a direct impact on how happy we are with our own beauty; c) relative beauty matters in an instrumental way, because the relative standing of an individual affects his consumption of standard goods. Each section has proposed a model to illustrate each of those issues and their implication for an individual's decision of how much to invest in her beauty capital.

References

Averett, S. and Korenman, S. (1996) "The economic reality of the beauty myth", *Journal of Human Resources* 31(2), pp. 304-330.

Barro, R.J. (2002) *Nothing is sacred*. The MIT Press. Cambridge, MA, pp. 67-73.

Becker, G.S. (1991) *A treatise on the family*. Harvard University Press. Cambridge, MA.

Becker, G.S. and Murphy, K.M. (2000) *Social economics*. Belknap Press of Harvard University Press. Cambridge, MA.

Becker, G.S., Murphy, K.M. and Werning, I. (2000) "Status, lotteries and inequality". Manuscript. University of Chicago.

Biddle, J.E. and Hamermesh, D.S. (1998) "Beauty, productivity and discrimination: lawyers' looks and lucre", *Journal of Labor Economics* 16, pp.172-201.

Bosman et al. (1997) "Business success and businesses' beauty capital". NBER working paper #6083.

Cole H.L., Mailath, G.J. and Postlewaite, A. (1992) "Social norms, savings behavior, and growth", *Journal of Political Economy* 100, pp. 1092-1125.

Cole H.L., Mailath, G.J. and Postlewaite, A. (1995) "Incorporating concerns for relative wealth into economic models", *Federal Reserve Bank of Minneapolis Quarterly Review* 19(3), pp. 12-21.

Economist, The. (2003) "The beauty business" May 24th, p.69-71.

Etcoff, N. (1999) *Survival of the prettiest.* Doubleday. New York, NY. Chapter 3.

Hamermesh, D.S. and Biddle, J.E. (1994) "Beauty and the labor market", *American Economic Review* 84, pp. 1174-1194.

Hamermesh, D.S., Meng, X. and Zhang, J. (2002) "Dress for succes: does primping pay?", *Labour Economics* 9(3), pp. 361-373.

Hamermesh, D.S. and Parker, A.M. (2003) "Beauty in the classroom: professors' pulchritude and putative pedagogical productivity". NBER working paper #9853.

Register, C.A. and Williams, D.R. (1990) "Wage effects of obesity among young workers", *Social Science Quarterly*, 71(1), pp. 130-141.

Wiederman, M.W. and Allegeier, E.R. (1994) "Male economic status and gender differences in mate selection preferences: evolutionary versus sociocultural explanations", in *Social stratification and socioeconomic inequality*, vol. 2, edited by Ellis, L. Praeger, London.