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ABSTRACT

Hobbies, Skills and Incentives to Work: The Happy Gardener and the Wealthy Golfer*

Two of the earliest inventions of a human capital-intensive technology were for the production of personal internal goods that enabled humans to derive more pleasure out of leisure, namely dance and music. I model the incentives to invent hobbies and to acquire hobby skills, and its implications for the incentives to work and to acquire professional skills. This model explains the economic origins of culture. It was no accident that the intricate steps of tango emerged in the shabby quarters of Buenos Aires, and that the Royal and Ancient Golf Club in St Andrews was the initiative of 22 noble and gentlemen of Fife.

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1 Introduction

'I got plenty o' nuttin',
and nuttin' is plenty for me.' (Porgy and Bess)

What does the break-dancing man in the street have in common with the Chief Executive on the golf course?

Some pleasures cannot be bought for money, such as the experience of a 'hole-in-one' in golf, mastering the intricate steps of tango, succeeding with your roses or playing a virtuous piece of music. Alfred Marshall (1890) classified such pleasures as an *internal-personal-non-transferable good*. The consumption and production of these goods cannot be separated. Hence, if you wish to consume it, you have to acquire the skills to produce it. The man in the street and the Chief Executive have both acquired such skills. The former because he has nothing, the latter because he has plenty.

This paper models the incentives to invent hobbies and to acquire hobby skills and its implications for the incentives to work and to acquire professional skills. This analysis also provides insights into the economic origins of culture. It was no accident that the intricate steps of tango emerged in the shabby quarters of Buenos Aires, nor that the Royal and Ancient Golf Club in St Andrews was the invention of 22 noble and gentlemen of Fife.[1]

In their seminal contributions on time, Becker (1965) and Burenstam Linder[2] (1970) both predicted that as the opportunity cost of time increases individuals would spend less time on time consuming activities. Spending plenty of time on cultivating

[1] www.theroyalandancientgolfclub.org

[2] Linder argued that being more productive at work, increases demand on leisure, due to an increase in opportunity cost of time. In order to solve that dilemma, individuals have an incentive to consume more per unit of time. In order to afford that increase in consumption they need to work more.

ones roses[3], or on gourmet cooking, or on the golf course, are therefore puzzling phenomena that can neither be explained by conspicuous consumption (Veblen 1899) nor social capital (Lebergott 1993) alone. If playing golf was purely a matter of networking and/or conspicuous leisure, why not use a more time efficient and less skill intensive way? On the contrary, this paper shows that these phenomena are consistent with rational utility maximisation once we endogenise the set of available consumption technologies and include the production of internal goods. Thus what might appear as conspicuous leisure may simply be a rational choice of a consumption technology that maximises the utility that can be derived from available resources.

Becker (1965) changed the basis for the theory of consumption by introducing the notion that market goods and time are inputs in a process that generates utility. Becker did not make a distinction between household production and leisure, which was noted by Gronau (1977;1980), who analysed household production of goods that are perfect substitutes to market goods. This paper takes one step further by endogenising the production technology for leisure and consumption.[4] Individuals can influence how much utility they can derive from their leisure by acquiring hobby skills, such as dancing, singing or hitting a golf ball, that have no value other than making leisure more productive. This paper thus extends the analysis of incentives to invest in human capital (Becker 1993) by introducing a new distinction for human capital which is to separate hobby skills from professional skills. This distinction enables us to model the economic origins of culture, how it relates to consumption, and its implications for labour market aspirations and attainments.[5] Furthermore, a theory for

[3]Roses being an example of a plant needing a lot of skill and attention for ultimate success.

[4]Endogenising the value of ones leisure by having children was analysed by Gronau (1973). However, that is different from having a hobby where skills are acquired.

[5]Barron et. al. (2000) provided empirical evidence of the implications from athletic hobbies on education and labour market participation. Their result that differences reflect differences across individuals in ability and value of leisure is being modelled in this paper. The problem for the

the incentives to invest in hobby skills is necessary to explain phenomena such as the invention and evolution of technologies for the production of music, including sheet music and compositions, and advanced musical instruments like the piano, which took generations. Whilst hobby skills have not been modelled before, their importance has been recognised by the educational establishment for long (Anderson 1955). Already in 1917 the National Education Association listed "preparation for the worthy use of leisure time" as one of the seven basic objectives of education.[6]

This paper introduces the notion that a hobby is a human capital-intensive technology for consumption. Some hobbies can be enjoyed without the input of material goods, such as singing and dancing, whereas others are technologies which require the input of both market goods and skill, such as playing an instrument or golf. Hence a hobby can be either a substitute or a complement to market goods depending on the nature of the hobby.[7]

On the assumption that the marginal utility is diminishing in both time spent consuming a good and the good (internal and or external) itself, the individual can derive more utility out of his time or material resources by acquiring hobby skills that will enable him to allocate either time or material resources more efficiently.[8] This is because a hobby provides an individual with the opportunity of doing something else gainful once he is bored of consuming the same market goods, and therefore allows him to get more utility out of leisure time. A hobby also enables the individual to

incentive to acquire professional skills if the individual is able to afford a high level of consumption is also a theme in Owen (1995). However, what makes hobbies interesting is that the effects from hobbies are not equivalent to the effects from consumption of market goods.

[6]National Education Association, *Cardinal Principles of Secondary Education.* Washington, D.C.: Bureau of Education, Department of the Interior, 1917.

[7]Costly hobbies can therefore explain the complementarity between time for leisure and recreation goods that was found in Owen (1971).

[8]Hence, the problem of optimal leisure is equivalent to the problem of the multi-plant firm.

derive more utility out of his resources. For example having ten pairs of specialised shoes for different activities gives higher utility than ten pairs of identical shoes, provided the individual has the skills to benefit from the different activities.[9]

This already gives us a clue why hobbies were invented. However, the fact that they increase utility is not a sufficient precondition. On the contrary, as the following two examples will illustrate, you would either have had to be poor or wealthy enough to do it.

Consider the following consumption technologies. One is to spend time drinking coffee at a cafe which is an external good requiring no hobby skills, the other is to dance tango, which is an internal good requiring skills. The individual will get more pleasure out of time if he does both. However, there is an opportunity cost of time to acquire the skills and to dance, which is the marginal utility of spending another hour drinking coffee. This cost will be lower, the less coffee he can afford to drink. The lower the opportunity cost of time, the more time he will spend dancing once he has the skills. Hence, the lower the level of consumption the lower the opportunity cost of acquiring the skills and the higher the marginal returns from having the skills. Thus the individual has to be poor enough to find it worthwhile inventing a hobby that is a substitute to drinking coffee. Furthermore, the poorer the greater the investment in hobby skills, that is the more intricate will the steps for the dance be.

Next consider the following alternative consumption technologies. One is having dinner, the second is playing golf. In this case the individual will have to be wealthy enough to invent the formalised version of the game. Wealth has three effects. On the one hand the nicer the dinners the individual is currently enjoying the higher the opportunity cost of time. On the other hand, the marginal loss in utility from using resource to invent the hobby is lower the wealthier the individual. Further-

[9]For example the marginal utility of a pair of dancing shoes will be higher the better a dancer the person is.

more, the wealthier the individual the more will the individual value having access to an alternative consumption technology that includes the production of a personal internal good. The latter effects will dominate if the wealth is high enough. Thus the individual will have to be wealthy enough to find it worthwhile investing in the skills to pursue a hobby that is a complement to consumption of external goods.[10]

Since hobbies require skills and increase welfare by expanding the set of available technologies for consumption, their role is fundamentally different from regular market goods. It is therefore of interest to analyse the interaction between hobbies and the incentive to acquire professional skills and to work, which sheds new light on classical phenomena such as income inequality and its persistence over time and the backward bending labour supply curve.[11]

For the man in the street the effort required to be an amazingly skilled street dancer will be lower than the effort required to acquire professional skills that would enable the same level of utility to be derived from consumption. Whereas by matching highly productive skills with advanced hobby skills the Chief Executive gets higher returns to the investment in both sets of skills since they are complementary. The hobby makes the marginal utility of consumption higher, and being able to afford to play with better golf clubs increases the returns to investing in hobby skills.[12]

[10]Note that a hobby is only preferred to alternative consumption technologies which do not require skills if the individual is skilled enough. The wealthier the individual, the more will he value the marginal effect from being more skilled since he can afford better equipment to match his skills.

[11]There is a related literature on how to make yourself happy by allocating time and money efficiently and raising your productivity potential. See Kendrick and Kendrick (1988)(with a focus on productivity) and Lebergott (1993)(with a focus on consumption). However, neither of those analysed the role played by hobby human capital and the production of internal goods.

[12]This argument is in line with Buiter and Kletzer (1991), who argue that productivity growth differentials will be persistent due to differences among the young on how much time they spend on education versus leisure. What I offer here is a mechanism that explains, why the value of leisure may differ between individuals and countries.

These two examples illustrate how the presence of hobbies will increase income inequality and its persistence across generations, since the poor have incentives to acquire free hobbies that weaken their incentives to acquire professional skills and to work, whereas the relatively more wealthy have incentives to acquire skills for costly hobbies that increase their incentives to acquire professional skills. [13] This is because free hobbies have the same effect on incentives to acquire professional skills and to work as wealth. Whereas costly hobbies have a more positive effect on incentives to acquire professional skills than monetary returns to those skills. This is because hobbies augments the set of consumption technologies and thus the marginal utility of income, whereas a higher income simple means the individual can consume more for a given set of consumption technologies.

The model also provides an argument in favour of accumulation of hobby skills in parallel with professional skills. When individuals have neither professional nor hobby skills their opportunity cost of time will be the lowest. If they delay acquiring one set of skills, they will acquire less skills in total since their opportunity cost of time will be higher once they have skills. Since welfare is increasing in both professional and hobby skills, there is thus an argument for schools to indeed prepare the pupils for gainful leisure as well as for professional activities.

Hobby human capital sheds new light on several old phenomena and enables the modelling of several new phenomena which is why it is a useful analytical concept.

The paper proceeds as follows. Optimal leisure is derived in Section 2. In Section 3 I analyse optimal time spent working and how it depends on wealth and skills. The following sections address the dynamic problem of incentives to invent hobbies when

[13] Martin (1995) examined leisure in southwestern Pennsylvania over the period 1800-1850. An interesting observation was to what extent leisure activities preserved class differences. In my paper I show how these differences actually arise, without any ideological reasons to keep any one out of the Club.

the income is given, Section 4, and incentives to acquire hobby and professional skills when the income depends on skills and time spent working, Section 5. The paper concludes with a discussion of extensions and various applications of the hobby human capital model in Section 6.

2 Optimal leisure

Following Becker (1965) a household is seen as a producer of goods as well as a utility maximiser. This section extends his analysis by noting that there exist different technologies for consumption that may or may not involve skills, the use of resource, and fixed time commitments. Since a hobby is a human capital-intensive technology for consumption of internal and external goods, an individual who has hobby skills can optimise his leisure by allocating time and resources optimally using different consumption technologies.

The individual produces goods (internal or external) $z_i > 0$, using a production technology $g_i(H_i, x_i)$ with inputs human capital H_i, and money x_i, where $\partial g_i/\partial H_i \geq 0$ and $\partial g_i/\partial x_i \geq 0$. Hence, it is assumed that hobby human capital and money have either a positive or no impact on the quantity of the good produced.

Let λ_i be the share of leisure time spent consuming good i. The individual derives utility from spending time consuming these goods $u(\lambda_i, z_i)$. Humans get bored and impatient the more time and resource they use to consume a good. Hence, the marginal utility is diminishing in both the quantity consumed and the share of time spent consuming the good. Thus the utility function is strictly concave in both arguments, $\partial u_i/\partial \lambda_i > 0$, $\partial^2 u_i/\partial^2 \lambda_i < 0$,$\partial u_i/\partial z_i > 0$, $\partial^2 u_i/\partial^2 z_i < 0$, and $\partial^2 u_i/\partial x_i \partial \lambda_i \geq 0$.

An individual who has n different technologies for consumption can optimise his leisure by allocating time and resources across i different activities to maximise

$$\max_{\lambda_i, z_i} \sum_{i=1}^{n} u_i(\lambda_i, z_i) \tag{1}$$

subject to the production technologies

$$z_i = g_i(H_i, x_i) \tag{2}$$

the time constraint

$$\sum_{i=1}^{n} \lambda_i = 1, \tag{3}$$

and the budget constraint

$$\sum_{i=1}^{n} x_i \leq W. \tag{4}$$

Substitution of the production technologies and $\lambda_n = 1 - \sum_{i=1}^{n-1} \lambda_i$ and $x_1 = W - \sum_{i=2}^{n} x_i$ into the objective function and maximising over time λ_i and money x_i spent on activity i the first order conditions for an interior solution for λ_i and x_i become

$$\frac{\partial u_i}{\partial \lambda_i} - \frac{\partial u_n}{\partial \lambda_n} = 0, \tag{5}$$

$$-\frac{\partial u_1}{\partial z_1}\frac{\partial g_1}{\partial x_i} + \frac{\partial u_i}{\partial z_i}\frac{\partial g_i}{\partial x_i} = 0. \tag{6}$$

The marginal utility of spending more time and money on each activity has to be equal, which gives optimal time slices λ_i^* and quantities $z_i^* = g_i(x_i^*, H_i)$ of goods produced. The maximised utility is a function of wealth W and a vector of hobby skills $\mathbf{H}$,

$$U(W, \mathbf{H}) = \sum_{i=1}^{n} u_i(\lambda_i^*, z_i^*). \tag{7}$$

Does hobby human capital imply the individual puts more or less time and resource into the hobby? Consider two alternative consumption technologies, $n = 2$. The individual chooses λ_1 and x_1 to maximise

$$\max_{\lambda_1, x_1} u_1(\lambda_1, g_1(x_1, H_1)) + u_2(1 - \lambda, g_2(W - x_1)) \tag{8}$$

which gives two first order conditions for an interior solution

$$\frac{\partial u_1}{\partial \lambda_1} - \frac{\partial u_2}{\partial \lambda_2} = 0, \tag{9}$$

$$\frac{\partial u_1}{\partial z_1}\frac{\partial g_1}{\partial x_1} - \frac{\partial u_2}{\partial z_2}\frac{\partial g_2}{\partial x_2} = 0. \tag{10}$$

Total differentiation of the first order conditions with respect to λ_1, x_1 and H_1, gives a system of equation of the following form $My = e$ where M is the Hessian of second order derivatives with element m_{ij} i'th row and j'th column, y is a vector $y = [\frac{d\lambda_1}{dH_1}, \frac{dx_1}{dH_1}]$ and $e = [e_1, e_2]$, where

$$e_1 = -\frac{\partial^2 u_1}{\partial \lambda_1 \partial z_1}\frac{\partial g_1}{\partial H_1} \tag{11}$$

$$e_2 = -\frac{\partial^2 u_1}{\partial^2 z_1}\frac{\partial g_1}{\partial x_1}\frac{\partial g_1}{\partial H_1} - \frac{\partial u_1}{\partial z_1}\frac{\partial^2 g_1}{\partial x_1 \partial H_1}. \tag{12}$$

Since the marginal utility of consumption is increasing in time spent consuming, and the production of the internal good is increasing in H_1, e_1 is clearly negative. The sign of e_2 is positive if the marginal productivity of resource put into the hobby is decreasing in the level of hobby skills. Whereas if hobby skills increase the marginal productivity of resources, the sign of e_2 is ambiguous.

Applying Cramer's rule the solution to this system of equations is given by

$$\frac{d\lambda_1}{dH_1} = \frac{m_{22}e_1 - m_{21}e_2}{detM}, \tag{13}$$

$$\frac{dx_1}{dH_1} = \frac{-m_{12}e_1 + m_{11}e_2}{detM} \tag{14}$$

Note that $detM > 0$, $m_{ii} < 0$ and $m_{ij} > 0$. Hence, if $e_2 > 0$ there will be two effects working in the opposite directions. However, it is possible to show that if $\frac{\partial^2 g_1}{\partial x_1 \partial H_1} > 0$, that is if hobby skills and the tools are complements, the positive effect dominates. Hence in this case having more hobby skills will imply the individual spends more time on the hobby.

Hence there are two mechanisms through which a hobby increases the utility of the individual. Hobbies also differ in terms of whether they require any resource other than time, and whether they involve a fixed time commitment or not. Let us consider an example with a Cobb-Douglas utility function $u(\lambda_i, z_i) = t_i^a z_i^{1-a}$. In this example we illustrate these two mechanisms by considering a free hobby with no time commitment and a costly hobby with a time commitment.

There are three available technologies for the production of goods. One does not require any hobby skills $g_1 = x_1$, for example dining. Let the time spent dining be denoted λ. Substitution of the budget constraint the money spent on dining will be $x_1 = W - x_2$. The utility in this activity is thus $u(\lambda, z_1) = \lambda^a (W - x_2)^{1-a}$. The individual has two sets of hobby skills. The first is a good with a technology $g_2 = x_2 H_C^{\frac{a}{1-a}}$, which uses both skills and money, for example golf. It takes a time slice μ, for example the time it takes to go round the golf course is given, but how much money the individual spends on clubs, golf shoes and so on is a choice variable. The utility if he commits himself to golf is thus $u(\mu, z_2) = (\mu H_C)^a x_2^{1-a}$. Finally, the individual can produce a third good $g_3 = H_F$ which requires skills and no money, for example singing. However, in this case the individual can decide how much time to spend singing. Substitution of the time constraint gives the utility from singing $u((1 - \lambda - \mu), z_3) = (1 - \lambda - \mu)^a H_F^{1-a}$.

The individual decides how much time to allocate to dining and singing, and how much money to allocate to dining and golf accessories. The maximisation problem is

$$\max_{\lambda, x_2} \lambda^a (W - x_2)^{1-a} + (\mu H_C)^a \, x_2^{1-a} + (1 - \lambda - \mu)^a H_F^{1-a}. \tag{15}$$

The first order conditions with respect to time spent dining λ and money spent on golf x_2 are

$$a \left(\frac{W - x_2}{\lambda} \right)^{1-a} - a \left(\frac{H_F}{1 - \lambda - \mu} \right)^{1-a} = 0, \tag{16}$$

$$-(1 - a) \left(\frac{\lambda}{W - x_2} \right)^{a} + (1 - a) \left(\frac{\mu H_C}{x_2} \right)^{a} = 0. \tag{17}$$

Time is allocated so that the marginal utility of spending an additional minute dining is equal to the marginal utility of singing another song. Money is optimally allocated, such that the marginal utility of the last golf sweater is equal to the marginal utility of another dinner jacket.

Solving for x_2 and λ in (16) and (17)

$$x_2^* = \frac{\mu H_C[W + H_F]}{(1-\mu) + \mu H_C}, \tag{18}$$

$$\lambda^* = \frac{(1-\mu)W - \mu H_C H_F}{W + H_F}. \tag{19}$$

These are very interesting. Note that having free hobby skills has the same effect on money spent on golf x_2^*, as wealth. Hence, in terms of optimising leisure, having skills that enable the production of personal internal goods is equivalent to having wealth. The wealthier and the more able a singer and a golfer the person is, the more money will he allocate to golf. Looking at time allocated to dining λ^*, the individual will allocate more time to dining the wealthier he is, and less time to dining the more skilled a singer and a golfer he is. This also implies that he will allocate less time to singing the wealthier he is.

Why will he spend more time singing the more skilled a golfer he is? The more skilled a golfer he is the more resource he will put into golf, and therefore less into dining. Having put less into dining reduces the opportunity cost of time singing, which makes the individual spend more time singing.

Why will he spend more resource on golf the more skilled a singer he is? The more skilled a singer, the more time will he spend singing, and thus less time dining. The marginal utility of putting more resource into dining, given that less time is spent dining is therefore lower, which makes it optimal to spend more resource on golf.

Substitution of x_2^* and λ^* into the objective function one gets an expression for the optimised utility of leisure given by

$$U(W, H_C, H_F) = [(1-\mu) + \mu H_C]^a \, [W + H_F]^{1-a}. \tag{20}$$

This can be compared with the utility the individual would have got had the only available consumption technology been dining, in which case he would have spent all his money and time dining $U(W) = W^{1-a}$. For $H_C > 1$, and $H_F > 0$, having

hobby skills will increase the pleasure he can derive out of his leisure. As long as he can sing at all, this will have a positive impact on his utility, whereas golf skills will only be valuable to the individual if he is sufficiently good a golfer. If he is not very good, committing himself to go round the golf course and spending money on golf accessories will leave him worse off, than not having committed himself to golf and enjoying longer more luxurious meals instead.

The marginal utility of wealth is increasing in H_C and decreasing in W and H_F.

$$\frac{\partial U}{\partial W} = (1-a)\left[\frac{(1-\mu)+\mu H_C}{W+H_F}\right]^a, \tag{21}$$

$$\frac{\partial^2 U}{\partial W \partial H_F} < 0, \tag{22}$$

whereas

$$\frac{\partial^2 U}{\partial W \partial H_C} > 0. \tag{23}$$

This is very interesting when we consider the incentive to improve the technology for the hobby. The wealthier the individual the stronger the incentive to improve the technology for the costly hobby and the weaker the incentives to improve the technology for the free hobby.

However, this is only true in a model where there is a fixed endowment of wealth and time for leisure. Next let us consider the incentives to work for an individual who has access to different consumption technologies. When the individual has the option to work, both money and time for leisure will be endogenously determined.

3 Incentives to work

Now consider an individual who has professional skills $S > 0$ that enable him to increase his wealth by working. How much time should an individual who has both professional and hobby skills optimally allocate to work?

The wealth is now decomposed into an endowment $\bar{w}$ and income from work, which depends on professional skills $S > 0$, monetary returns to skills $w > 0$, and time spent working t. Let $f(t, S)$ be a continuous function which is increasing in both arguments at a diminishing rate, that is $f_t > 0$, $f_S > 0$, and $f_{tt} \leq 0$, and $f_{SS} \leq 0$. Being more skilled does not reduce the marginal productivity at work, that is the cross derivative is $f_{tS} \geq 0$. The more skilled and the more time the individual works the more he produces. For each unit he produces he gets paid w. Hence the income is $wf(t, S)$.

The individual chooses how much to work, taking into account that he has $1 - t$ time left for leisure when he derives utility $U(W, \mathbf{H})$. The opportunity cost of working is that the individual will then be left with less time for leisure. Hence, it is assumed without loss of generality that the only disutility from work is that the individual has less time for leisure.[14]

The individual chooses t to maximise

$$\max_t (1 - t)U(W, \mathbf{H}) \tag{24}$$

subject to

$$W = wf(t, S) + \bar{w}. \tag{25}$$

Substitution of W into the objective function and maximising over t gives a first order condition for an interior solution,

$$-U(W, \mathbf{H}) + (1 - t)\frac{\partial U}{\partial W} w f_t(t, S) = 0. \tag{26}$$

At the optimum the opportunity cost of time, which is the value of optimal leisure has to be equal to the time spent on leisure times the marginal increase in utility from earning more times the wage times the marginal productivity of working more.

[14]This structure captures the fact that people compartmentalise work and leisure. Hence, what ever time is left for leisure will be optimised across leisure activities.

Total differentiation with respect to time t and hobby skills H_i gives

$$\frac{dt^*}{dH_i} = \frac{\frac{\partial U}{\partial H_i} - (1-t)\frac{\partial^2 U}{\partial W \partial H_i} w f_t}{-2\frac{\partial U}{\partial W} w f_t + (1-t)\left[\frac{\partial^2 U}{\partial^2 W}(w f_t)^2 + \frac{\partial U}{\partial W} w f_{tt}\right]}. \tag{27}$$

The denominator is the second order condition which has to be negative for the first order condition to be an optimum.

There are two effects from an increase in hobby skills. The first is the increase in opportunity cost of time $\partial U/\partial H_i > 0$, having a hobby makes leisure more valuable. The second is the effect from more hobbies on the marginal utility of earning more. As we saw earlier this latter effect depends on whether the hobbies are costly or free. The individual will definitely spend less time working if $\frac{\partial^2 U}{\partial W \partial H_i} < 0$, that is if the hobbies are free, but may work more if $\frac{\partial^2 U}{\partial W \partial H_i} > 0$, that is if hobbies are costly. This can happen if the hobby has a sufficiently positive impact on the marginal utility of increase in income.

The effect from wealth is

$$\frac{dt^*}{d\bar{w}} = \frac{\frac{\partial U}{\partial W} - (1-t)\frac{\partial^2 U}{\partial^2 W} w f_t}{-2\frac{\partial U}{\partial W} w f_t + (1-t)\left[\frac{\partial^2 U}{\partial^2 W}(w f_t)^2 + \frac{\partial U}{\partial W} w f_{tt}\right]}. \tag{28}$$

There are two effects from wealth. The first is the increase in opportunity cost of time. The second is the marginal effect on utility from earning more. These two effects work in the same direction, that is the individual spends less time working the larger the endowment of wealth. Hence, it is the same as the effect from free hobbies.

The effects from professional skills are,

$$\frac{dt^*}{dS} = \frac{\frac{\partial U}{\partial W} w f_S - (1-t)\left[\frac{\partial^2 U}{\partial^2 W} w f_t + \frac{\partial U}{\partial W} w f_{tS}\right]}{-2\frac{\partial U}{\partial W} w f_t + (1-t)\left[\frac{\partial^2 U}{\partial^2 W}(w f_t)^2 + \frac{\partial U}{\partial W} w f_{tt}\right]}. \tag{29}$$

In this case there are three effects. The first is the income effect being able to afford a higher level of consumption. Then there are two effects which determine how the marginal benefits from working are affected by being more skilled. The first is the effect on marginal utility of wealth when the individual earns more (which

is negative) the second is the marginal utility of wealth times the wage times the increase in marginal productivity of time spent working as a result of being more skilled (which is positive). Whether the individual works more or less depends on which effect dominates.

The effect from an increase in the wage is similar to the effect from professional skills,

$$\frac{dt^*}{dw} = \frac{\frac{\partial U}{\partial W} f(t,S) - (1-t)\left[\frac{\partial^2 U}{\partial^2 W} f(t,S) w f_t\right] + \frac{\partial U}{\partial W} f_t}{-2\frac{\partial U}{\partial W} w f_t + (1-t)\left[\frac{\partial^2 U}{\partial^2 W}(w f_t)^2 + \frac{\partial U}{\partial W} w f_{tt}\right]}. \tag{30}$$

There are three effects, and the total effect depends on whether the income or the substitution effect dominates.

Let $V(S, \mathbf{H}) = (1 - t^*(S, \mathbf{H}))U(W(t^*), \mathbf{H})$ denote the maximised utility, when the individual has professional skills that enables him to increase his income by working and spending less tim eon leisure.

Now consider our running example

$$V(S, H_F, H_C) = \max_t (1-t)\left[(1-\mu) + \mu H_C\right]^a \left[W + H_F\right]^{1-a} \tag{31}$$

subject to

$$W = wSt + \bar{w}. \tag{32}$$

Substitution of W in the objective function and maximising over share of time spent working t gives a first order condition for an interior solution

$$\left(\frac{(1-\mu) + \mu H_C}{W + H_F}\right)^a \left[(1-t)(1-a)wS - wSt - \bar{w} - H_F\right] = 0. \tag{33}$$

The marginal utility from being able to afford a higher level of consumption has to be equal to the opportunity cost of having less time to spend on leisure. Solving for the optimal time spent working,

$$t^* = \frac{(1-a)wS - \bar{w} - H_F}{wS(2-a)}. \tag{34}$$

This gives time spent on leisure

$$1 - t^* = \frac{wS + \bar{w} + H_F}{wS(2-a)} \tag{35}$$

and total resources

$$W = \frac{(1-a)[wS + \bar{w}] - H_F}{(2-a)}. \tag{36}$$

There is only an interior solution for

$$wS > \frac{\bar{w} + H_F}{1-a}. \tag{37}$$

The more the individual values spending time consuming goods, higher a, the higher his wealth and free hobby skills, the more skilled and the higher monetary returns to skills are required for him to choose to work. If the individual is impatient and puts larger weight on the level of consumption, that is lower a, he will be willing to work with less skills and or lower returns to his skills.

If the individual has no wealth or no free hobby skills, the income and substitution effect exactly cancel for Cobb-Douglas preferences. However this is no longer the case if the individual has either free hobby skills or wealth in which case an increase in wage will have a positive effect on time spent working which will be stronger the wealthier the person.

$$\frac{dt^*}{dw} = \frac{\bar{w} + H_F}{w^2 S(2-a)} > 0. \tag{38}$$

Whilst the substitution effect is the same, the income effect is smaller the wealthier the person due to diminishing marginal utility of goods, that is the incentive to work less is smaller, which is why the person with free hobby skills responds positively to an increase in salary and is willing to work more, whereas the individual with no free hobbies or wealth is unaffected.

When there is an interior solution we can substitute for t^* into the objective function to get an expression for the maximised utility when the individual has both professional skills and hobby skills,

$$V(S, H_C, H_F) = \frac{(1-a)^{1-a}}{wS} \left[(1-\mu) + \mu H_C\right]^a \left[\frac{wS + \bar{w} + H_F}{2-a}\right]^{(2-a)}. \tag{39}$$

Taking the first derivative with respect to skills and wage we get,

$$\frac{\partial V}{\partial H_C} = \frac{\mu a}{(1-\mu)+\mu H_C} V \tag{40}$$

$$\frac{\partial V}{\partial H_F} = \frac{2-a}{wS+\bar{w}+H_F} V \tag{41}$$

$$\frac{\partial V}{\partial S} = \left[\frac{(2-a)w}{wS+\bar{w}+H_F} - \frac{1}{S}\right] V = \frac{t^* w(2-a)}{wS+\bar{w}+H_F} V \tag{42}$$

$$\frac{\partial V}{\partial w} = \left[\frac{(2-a)S}{wS+\bar{w}+H_F} - \frac{1}{w}\right] V = \frac{t^* S(2-a)}{wS+\bar{w}+H_F} V \tag{43}$$

The maximised utility is increasing in hobby skills, and in professional skills and wage if the individual is working.

Whilst an increase in wealth or wage both have a positive effect on the marginal utility of H_C, they differ regarding their effects on the marginal utility of H_F. If the working professional inherits money this will increase the marginal utility of his free hobby skills

$$\frac{\partial^2 V}{\partial H_F \partial \bar{w}} = \frac{(2-a)(1-a)V}{(wS+\bar{w}+H_F)^2} > 0. \tag{44}$$

whereas if he gets an increase in salary this will decrease his marginal utility of having a free hobby

$$\frac{\partial^2 V}{\partial H_F \partial w} = -\frac{(2-a)(awS+\bar{w}+H_F)V}{w(wS+\bar{w}+H_F)^2} < 0. \tag{45}$$

Thus transfer of wealth is consistent with having stronger incentives to improve the technology for a free hobby, whereas an increase in returns to being a professional is not.[15]

Another cross derivative of interest is

$$\frac{\partial^2 V}{\partial S \partial w} = -\frac{((1-a)wS-\bar{w}-H_F)V}{wS(wS+\bar{w}+H_F)} < 0. \tag{46}$$

The marginal value of professional skills if the salary is higher is in fact decreasing. This is due to diminishing marginal utility of goods.

[15]This result is very interesting since this is a property that characterised the bourgeoise who had both wealth and an income. Hence it was no accident that the height of the technical development of the piano coincided with the era of the bourgeoise.

The marginal value of a costly hobby is increasing in the stock of free hobbies, and vice versa, that is

$$\frac{\partial^2 V}{\partial H_C \partial H_F} = \frac{\mu a}{(1-\mu)+\mu H_C} \times \frac{2-a}{wS+\bar{w}+H_F} V > 0. \tag{47}$$

However, the marginal value of costly hobbies is decreasing in the stock of costly hobbies,

$$\frac{\partial^2 V}{\partial^2 H_C} = -\frac{\mu^2 a(1-a)}{((1-\mu)+\mu H_C)^2} V < 0, \tag{48}$$

whereas the marginal value of free hobbies is increasing in the stock of free hobbies (as is wealth)

$$\frac{\partial^2 V}{\partial^2 H_F} = \frac{(2-a)(1-a)}{(wS+\bar{w}+H_F)^2} > 0. \tag{49}$$

Hence, having free hobbies increases the incentive to acquire both more free and more costly hobbies. This is because a free hobby has the same effect as wealth, thus inducing the individual to work less and thus benefitting more from being able to increase the value of his leisure. Costly hobbies give the individual a stronger incentive to acquire professional skills and free hobby skills, but weaker incentives to acquire more costly hobby skills. This is because even if the hobby skills increases the returns to consumption they are still diminishing.

The function is concave in S unless the individual is sufficiently wealthy in which case it is convex.

$$\frac{\partial^2 V}{\partial^2 S} = -\frac{awS[(1-a)wS-\bar{w}-H_F]-(\bar{w}+H_F)^2}{S^2(wS+\bar{w}+H_F)^2}. \tag{50}$$

This is because more free hobbies will make the individual choose to work more, the higher his professional skills, since the income effect will be smaller than the substitution effect. Thus even though the marginal utility of goods is diminishing, the fact that the individual will work more the more skilled, makes the function convex. For example consider wealth such that the individual is not working that is $t^* = 0$. If the individual did increase his professional skills, he would then choose to work.

4 The economic origins of culture

One important class of inter-temporal decisions that humans could make prior to the existence of capital markets were those relating to developing technologies, including skills and tools, that would enable them to produce desirable goods in future periods. In this section I consider individuals who have fixed resources, but who can choose to spend time and possibly resource on inventing a technology for the production of an internal good.

Assume that the individual has access to one consumption technology for an external good which uses material resources only, that is $z_1 = g_1(x_1)$. The individual could either invent a technology for an internal good that requires human capital only $z_i = g_i(H_i)$, such as a dance, or one that requires both human capital and resource $z_i = g_i(H_i, x_i)$, such as golf. The production technology for acquiring skills can be represented by a continuous function $h(\mu, x, \theta)$, where $h_\mu > 0$, $h_x \geq 0$ and $\theta > 0$ represents ability. The more able the greater the skills, $h_\theta > 0$. Time is a necessary input to acquire hobby skills, whereas money may or may not be depending on the nature of the hobby.

Consider a two period model. The endowment income per period is ω. No transfers can be made between the two periods.[16]

First consider the case where only time is required to invent a technology involving acquiring hobby skills, that is $H = h(\mu, \theta)$. In the first period the individual decides how much time to spend on inventing for example new dance steps. In the second period, the individual then allocates time optimally between consumption of for example coffee (an external good) and dancing (an internal good).

[16]There are several instances where this would be the case, such as in primitive societies with no credit markets or ability to store, but also for landlords in the past. It would also apply to people living hand to mouth, and more generally those who are credit constrained.

The individual's objective is to maximise utility over the two periods

$$u(\lambda, \omega) + U(\omega, H) \tag{51}$$

subject to

$$H = h(\mu, \theta), \tag{52}$$

and the time constraint

$$\lambda + \mu = 1. \tag{53}$$

Substitution of the constraints in the objective function

$$u(1 - \mu, \omega) + U(\omega, h(\mu, \theta)) \tag{54}$$

and maximising over μ gives a first order condition for an interior solution

$$-u_\lambda(\lambda, \omega) + U_H(\omega, H)h_\mu = 0. \tag{55}$$

The time spent acquiring skills is decreasing in the endowment income ω. Total differentiation with respect to μ and ω gives

$$\frac{d\mu^*}{d\omega} = \frac{u_{\lambda\omega}(\lambda, \omega) - U_{H\omega}(\omega), H)h_\mu}{u_{\lambda\lambda}(\lambda, \omega) + U_{HH}(\omega, H)(h_\mu)^2 + U_H(\omega, H)h_{\mu\mu}} < 0. \tag{56}$$

The individual will spend less time inventing a free hobby the wealthier he is. There are two reasons for this. The first is the increase in the opportunity cost of time. The second is the effect from wealth on the marginal utility from hobby skills, which is negative for free hobby skills. Hence, both effects work in the same direction. This furthermore implies that if the individual is too wealthy he will have no incentive to invent a free hobby.

Consider the following example with Cobb-Douglas utility and constant marginal opportunity cost of time.

$$\max_\mu (1 - \mu)\omega^{1-a} + [\omega + \theta\mu]^{1-a} \tag{57}$$

The first order condition is

$$-\omega^{1-a} + (1-a)\theta\left[\omega + \theta\mu\right]^{-a} = 0 \tag{58}$$

solving for optimal time spent inventing

$$\mu = \frac{1}{\theta}\left[\left(\frac{(1-a)\theta}{\omega^{1-a}}\right)^{\frac{1}{a}} - \omega\right]. \tag{59}$$

Hence, the individual will only find it worthwhile inventing skills if the wealth relative to ability is sufficiently low $\omega/\theta < (1-a)$. It has to be lower the greater the weight the individual puts on having time to do things, that is a is high.

Hence it was no accident that the intricate steps of tango emerged in the shabby quarters of Buenos Aires. The poorer relative to ability, the greater the incentive to create an internal good that would generate immense pleasure.

This mechanism thus explains why some of the earliest examples of human capital-intensive technologies were inventions that enabled humans to derive more pleasure out of leisure, such as gardening, dance and music. There were incentives to invent these activities in primitive societies since the opportunity cost of time was low as a result of the low level of consumption.

Next consider the case where both time and resource are needed to acquire the skills. Thus $H = h(\mu, x, \theta)$. The individual then decides both how much time μ and resource x he is willing to spend to enable him to enjoy a hobby in the future. The individual maximises

$$\max_{\mu,x} u(\lambda, \omega - x) + U(\omega, H), \tag{60}$$

subject to

$$H = h(\mu, x, \theta), \tag{61}$$

and the time constraint

$$\lambda + \mu = 1. \tag{62}$$

Substitution of the constraints in the objective function gives

$$u(1-\mu, \omega - x) + U(\omega, h(\mu, x, \theta)) \tag{63}$$

and maximising over μ and x gives first order conditions for an interior solution

$$-u_\lambda(1-\mu, \omega - x) + U_H(\omega, H)h_\mu = 0, \tag{64}$$

$$-u_z(1-\mu, \omega - x) + U_H(\omega, H)h_x = 0. \tag{65}$$

The effect on hobby skills from wealth depends on how the optimal time and resource spent on the hobby respond to changes in wealth. That is

$$\frac{dH}{d\omega} = h_\mu \frac{d\mu}{d\omega} + h_x \frac{dx}{d\omega}. \tag{66}$$

Total differentiation with respect to μ, x and ω gives a system of equations of the following form

$$My = e, \tag{67}$$

where M is the Hessian of the second order derivatives of the objective function with elements m_{ij}, $y = [\frac{d\mu}{d\omega}, \frac{dx}{d\omega}]$ and $e = [e_1, e_2]$ where

$$e_1 = u_{\lambda z} - U_{H\omega}h_\mu, \tag{68}$$

and

$$e_2 = u_{zz} - U_{H\omega}h_x. \tag{69}$$

The sign of e_1 depends on two factors, which work in the opposite direction if it is a costly hobby. The first is the change in marginal utility from more time spent consuming if the level of consumption increases, which is positive. The second is the change in the marginal utility from more hobby skills if wealth increases. The second effect is more likely to dominate the more able the individual is in acquiring the skills,

i.e. h_μ higher, and the more the skills allow him to enjoy his resources more. That is the extent to which skills and equipment complement each other.[17]

The sign of e_2 depends on two factors. First the change in marginal utility when the consumer can afford more, which is negative. Second the change in the marginal utility of hobby skills that are due to having to put resource into the process. For a costly hobby these two effects work in the same direction, that is e_2 is unambiguously negative. Applying Cramer's rule, the total effect on hobby skills from a greater endowment can be written,

$$\frac{dH}{d\omega} = \frac{[h_\mu m_{22} - h_x m_{12}]e_1 - [h_\mu m_{21} - h_x m_{11}]e_2}{detM}. \tag{70}$$

Note that whilst $m_{ii} < 0$ follows from second order conditions the sign of $m_{ij} = u_{\lambda z} + U_{HH}(h_\mu)^2 + U_H h_{\mu\mu}$ is ambiguous. However, substitution for m_{ii} and simplifying, the signs of the composite parameters are unambiguous,

$$\frac{dH}{d\omega} = \frac{\overbrace{[h_\mu(u_{zz} + U_H h_{xx}) - h_x(u_{\lambda z} + U_H h_{\mu x})]}^{(-)} e_1 - \overbrace{[h_\mu(u_{z\lambda} + U_H h_{x\mu}) - h_x(u_{\lambda\lambda} + U_H h_{\mu\mu})]}^{(+)} e_2}{\underbrace{detM}_{(+)}} \tag{71}$$

Hence the effect is unambiguously positive if e_1 and e_2 are both negative. Thus a sufficiently able individual h_μ high, has to be wealthy enough to find it worthwhile inventing a costly hobby.

Now let us consider our running example with Cobb-Douglas utility where the costly hobby involved a fixed time commitment, but enabled the individual to allocate resources freely. Assume that the cost of acquiring the skills is $q(1-\lambda)$, for example the price of dance lessons. This example illustrates that it was no accident that the wealthy introduced the formal ball with elegant dresses.

The individual chooses how many dance lessons to attend prior to the ball $(1-\lambda)$ at

[17]For example the more skilled a musician the more you appreciate having a high quality instrument, since you are able to make it sound magnificent.

a cost q per lesson. In the second period the individual allocates resources optimally between money spent on the gown for the ball and clothes for dining, given her dancing skills and the duration of the ball. Thus she maximises,

$$\max_{\lambda} \lambda^a \left(W - q(1-\lambda)\right)^{1-a} + \left[\mu + (1-\mu)H_C\right]^a W^{1-a}\Big] \tag{72}$$

subject to

$$H = \theta(1-\lambda). \tag{73}$$

Substitution of H and maximising over λ gives a first order condition

$$a\left(\frac{W-q(1-\lambda)}{\lambda}\right)^{1-a} + (1-a)\left(\frac{\lambda}{W-q(1-\lambda)}\right)^{a} q - a(1-\mu)\theta\left[\frac{W}{\mu+(1-\mu)H_C}\right]^{1-a} = 0. \tag{74}$$

There is only an interior solution if this function is negative at $\lambda = 1$,

$$aW^{1-a}[1-\theta(1-\mu)\mu^{a-1}] + (1-a)W^{-a}z < 0. \tag{75}$$

Solving for W one gets

$$W > \frac{1-a}{a}\frac{q\mu^{1-a}}{\theta(1-\mu)-\mu^{1-a}}. \tag{76}$$

Provided that a sufficient slice of time has been allocated to the hobby $\mu^{1-a} < \theta(1-\mu)$, the individual has to be wealthy enough to invent the ball. A time commitment implies that the individual will have strong enough incentives to acquire skills that enable her to really enjoy the ball. Furthermore to benefit from the opportunity of getting an additional dress, she also has to be wealthy enough.

A costly hobby allows the wealthy to derive more pleasure out of consumption, whereas a free hobby allows the poor to derive more pleasure out of time.

Next we shall consider the incentives to acquire skills when resources and time for leisure are endogenously determined.

5 Incentives to acquire skills

This section considers the inter-temporal decisions regarding skill accumulation. There are two periods. In the first period the individual can acquire skills in anticipation of optimising work and leisure in the future. Some individuals acquire hobby and professional skills in parallel, others acquire the professional skills first, and attend evening classes as adults, and some acquire hobby skills early. Hence, there are three possibilities regarding the sequencing of these skills. First, the professional who wants to improve his leisure. Second, the hobby person, who wants to make a career. And finally, the person who was brought up acquiring both sets of skills in parallel.

5.1 Hobby skills

Consider an individual who has professional skills but no hobby skills. The individual can spend time and resource to acquire skills in order to derive more pleasure out of leisure in the future.

Consider two periods. In the first period the individual decides how much time to allocate to acquiring hobby skills μ and how much to work which will determine how much he can consume net of the cost for the hobby courses $q\mu$. He does this in anticipation of optimising his work and consumption in the future. It is assumed that resources cannot be transferred between periods.[18]

[18]This assumption makes the results directly comparable with the section on the economic origins of culture, and focusses the analysis on the main mechanism at work. In a related paper Sällström Matthews (2007), has analysed the optimal consumption patterns over time, and find that consumption smoothing is not optimal once we take into account that consumption takes time and that the marginal value of consumption depends on other factors such as children and hobby skills since individuals will have an incentive to postpone consumption to periods when they have time and skills to enjoy it. Hence, even if capital markets were perfect, rational students would consume less when busily acquiring skills than as middle aged professionals.

The optimisation problem is in this case,

$$\max_{t,\mu} U(\lambda, z) + V(S, H) \tag{77}$$

subject to

$$\begin{aligned} z &= x & (78)\\ x &\leq \bar{w} + wf(S,t) - q\mu & (79)\\ H &= h(\mu, \theta) & (80)\\ t + \mu + \lambda &= 1. & (81) \end{aligned}$$

The first order condition with respect to time spent working is

$$-u_\lambda + u_z w f_t = 0 \tag{82}$$

hence the marginal utility of spending more time on consumption should be equal to the marginal utility of consuming more. The first order condition with respect to time spent acquiring hobby skills is

$$-u_\lambda - u_z q + V_H h_\mu = 0 \tag{83}$$

The marginal cost of hobby skills, is the marginal utility of spending more time and resource consuming which have to be equal to the marginal valule of having hobby skills in the future.

Is it the more or the less skilled professional who has the strongest incentive to acquire hobby skills?

Total differentiation with respect to t, μ, S, gives a system of equations of the following form $My = e$, where M is the Hessian with element m_{ij} i'th row and j'th column, a vector $y = [\frac{dt}{dS}, \frac{d\mu}{dS}]$, and $e = [e_1, e_2]$ where

$$e_1 = [u_{\lambda z} - u_{zz} w f_t]\, w f_S - u_z w f_{tS} \tag{84}$$

This is the effect on the first order condition for time spent working from a change in skills. There is an income effect inducing the individual to work less if more skilled, and a substitution effect to work more. The sign of e_1 depends on which one that dominates. Differentiating the first order condition for optimal time spent on acquiring hobby skills with respect to professional skills gives

$$e_2 = [u_{\lambda z} + qu_{zz}]\, wf_S - V_{HS}h_\mu. \tag{85}$$

This one is unambiguously positive if the individual acquires free hobby skills, that is if $q = 0$ and $V_{HS} < 0$. If the individual acquires costly skills, it is unambiguously negative for q high enough. Applying Cramer's rule the total effect on time spent working is

$$\frac{dt}{dS} = \frac{m_{22}e_1 - m_{21}e_2}{detM} \tag{86}$$

and on time spent acquiring hobby skills

$$\frac{d\mu}{dS} = \frac{-m_{12}e_1 + m_{11}e_2}{detM}. \tag{87}$$

Note that $m_{ii} < 0$ and $m_{ij} > 0$. Furthermore e_1 will be small, and can even be zero if the substitution and income effect exactly cancel one another. Thus whether having more professional skills induces more or less work, and more or less investment in hobby skills depends on the nature of the hobby skills.

If hobbies are costly, and it is costly to acquire the skills, then time spent working and time spent acquiring hobby skills will both be increasing in professional skills. Thus we get the 'work hard, play hard result'. Whereas if the hobby is free, time spent working and acquiring hobby skills will both be decreasing in professional skills.

5.2 Professional skills

Consider the incentives to acquire professional skills if the individual has hobby skills. Assume that acquiring professional skills is like working, hence it implies there is less

time for leisure. The benefits from working in this case are delayed to the future when the individual will be able to increase consumption by spending some time working. Let $s(t, \phi)$ be a continuous function with $s_t > 0$, and $s_{tt} < 0$ for the production of professional skills.

In the first period the individual spends time t and optimises his leisure for the remaining $1 - t$. Thus

$$\max_t (1-t)U(\bar{w}, H) + V(S, H) \tag{88}$$

subject to

$$S = s(t, \phi). \tag{89}$$

The first order condition with respect to t for an interior solution is

$$-U(\bar{w}, H) + V_S s_t = 0. \tag{90}$$

Total differentiation with respect to t, H, w and $\bar{w}$,

$$\frac{dt}{dH} = \frac{U_H - V_{SH} s_t}{V_S s_{tt}} \tag{91}$$

$$\frac{dt}{dw} = \frac{-V_{Sw} s_t}{V_S s_{tt}} \tag{92}$$

$$\frac{dt}{d\bar{w}} = \frac{U_{\bar{w}} - V_{S\bar{w}} s_t}{V_S s_{tt}} \tag{93}$$

If the hobby is free $V_{SH} < 0$, all three effects are negative. Thus if the individual has a free hobby the individual will acquire less professional skills, the more skilled he is. It should also be noted that the individual will acquire less professional skills if he expects a high return to his skills, since $V_{Sw} < 0$.

If the individual has costly hobby skills, but little wealth, that is $V_{SH} > 0$, and U_H is small. The individual will acquire more professional skills the more skilled he is as a golfer. In this case having a costly hobby gives stronger incentives to make a career than expecting high monetary returns on ones professional skills.

This also shows the implications for labour market aspirations from intergenerational transfer of hobby skills. The poor transfer free hobbies to their children which

give them weaker incentives to acquire professional skills, whereas the rich transfer costly hobby skills to their children which give them stronger incentives to acquire professional skills. The model thus not only explains income inequality, but also persistence over time.

5.3 Professional and hobby skills

Consider an individual who has neither professional nor hobby skills, but can prepare himself for a prosperous future by acquiring both in period one when he only has his endowment $\bar{w}$ to consume.

The individual chooses how much time to spend acquiring professional skills t and how time to attend hobby courses μ at a cost $q\mu$. Thus he maximises

$$\max_{t,\mu} u(\lambda, z) + V(S, H) \tag{94}$$

subject to

$$\begin{aligned} z &= x && (95)\\ x &\leq \bar{w} - q(\mu) && (96)\\ H &= h(\mu, \theta) && (97)\\ S &= s(t, \phi) && (98)\\ t + \mu + \lambda &= 1 && (99) \end{aligned}$$

The first order conditions with respect to t is

$$-u_\lambda + V_S s_t = 0 \tag{100}$$

He will acquire professional skills up to a level where the marginal cost of having less time consuming good z, should be equal to the marginal benefit in the future from having spent more time acquiring skills. Note that the opportunity cost will be lower, the more time and resource are spent acquiring hobby skills in the meantime.

The first order condition for hobby skills is

$$-\left[u_\lambda + u_z q\right] + V_H h_\mu = 0. \tag{101}$$

The opportunity cost of acquiring hobby skills depends on how much leisure the individual is enjoying and the marginal change in utility from spending less time and resource on good z which has to be equal to the marginal benefit of hobby skills times the productivity of the individual in acquiring those skills h_μ. The opportunity cost is decreasing in t but increasing in time and resource put into acquiring hobby skills.

However, it is interesting to notice that acquiring both sets of skills simultaneously actually increases the incentives to acquire both sorts of skills. This is because being busy daytime with a professional course and evening time with a hobby course implies the opportunity cost of time is actually low! Since the individual does not have any skills, the opportunity cost of time is lower both than in the case where the individual already had hobby skills, and the case where the individual already had professional skills.

Hence there is an advantage to acquire professional and hobby skills when we are young and our opportunity cost of time is low, since we will then end up with a larger stock of both.

The question is how these incentives are affected by endowment of wealth $\bar{w}$, the returns to professional skills w and to the ability of the individual θ, ϕ.

First consider the effect from wealth. Total differentiation with respect to t, μ and $\bar{w}$, which gives us a system of equations $My = e$, as before, applying Cramer's rule,

$$\frac{dt}{d\bar{w}} = \frac{m_{22}(u_{\lambda z} - V_{S\bar{w}} s_t) + m_{12}(V_{H\bar{w}} h_\mu - [u_{\lambda z} + u_{zz} q])}{detM} \tag{102}$$

$$\frac{d\mu}{d\bar{w}} = \frac{-m_{21}(u_{\lambda z} - V_{S\bar{w}} s_t) - m_{11}(V_{H\bar{w}} h_\mu - [u_{\lambda z} + u_{zz} q])}{detM} \tag{103}$$

Note that $m_{ij} = u_{\lambda\lambda} + q u_{\lambda z} + V_{HS} s_t h_\mu$. Hence, it is negative for free hobbies and positive for costly hobbies.

Whether wealth induces the individual to acquire more professional skills or not depends on whether the hobby skills he is acquiring in parallel are free or costly hobbies. If they are free, wealth induces him to acquire less professional skills, whereas if they are costly he will acquire more professional skills.

There are two effects that determine whether more initial wealth induces the individual to acquire more or less hobby skills. The first effect is positive if free hobbies and negative if costly hobbies. The second effect is more likely to be positive the more able the individual, that is h_{mu} higher, and the more costly the skills that is q high.

The next question is how higher returns to professional skills will influence the choices. We then get

$$\frac{dt}{dw} = \frac{-m_{22}V_{Sw}s_t + m_{12}V_{Hw}h_\mu}{detM} \tag{104}$$

$$\frac{d\mu}{dw} = \frac{m_{21}V_{Sw}s_t - m_{11}V_{Hw}h_\mu}{detM} \tag{105}$$

There are two effects on incentives to acquire professional skills. The first one is negative due to diminishing returns to income $V_{Sw} < 0$. The second effect is positive for both costly and free hobbies.

There are also two effects on the incentive to acquire hobby skills. The first one is positive for free hobbies, and negative for coslty hobbies, whereas the second is negative for free hobbies and positive for costly hobbies. If the second effect dominates, this implies that higher returns to skills induces the individual to acquire less free hobbies and more costly hobbies.

How are these choices affected by the ability of the individual. This is captured by the parameters θ (ability for hobby skills) and ϕ (ability for professional skills). Does the individual spend more or less time acquiring skills the more able the individual is?[19]

[19]This is an interesting issue given Owen's (1995) findings relating to how much time students spend working.

Differentiating with respect to θ and ϕ gives

$$\frac{dt}{d\phi} = \frac{-m_{22}[V_{SS}s_t s_\phi + V_S s_{t\phi}] + m_{12}V_{HS}h_\mu s_\phi}{detM} \tag{106}$$

$$\frac{dt}{d\theta} = \frac{-m_{22}(V_{SH}s_t h_\theta) + m_{12}(V_{HH}h_\mu h_\theta + V_H h_{\mu\theta})}{detM} \tag{107}$$

$$\frac{d\mu}{d\phi} = \frac{m_{21}[V_{SS}s_t s_\phi + V_S s_{t\phi}] - m_{11}V_{HS}h_\mu s_\phi}{detM} \tag{108}$$

$$\frac{d\mu}{d\theta} = \frac{m_{21}(V_{SH}s_t h_\theta) - m_{11}(V_{HH}h_\mu h_\phi + V_H h_{\mu\theta})}{detM} \tag{109}$$

Being able at acquiring professional skills ϕ induces the individual to acquire more professional skills and more hobby skills if costly h and less if free. Furthermore being able at acquiring hobby skills also induces the individual to acquire both more professional and more hobby skills if the hobby is costly, and less if the hobby is free.

6 Discussion

The analysis in this paper has shown that free hobbies have the same effect as wealth whereas costly hobbies gives a stronger incentive to work and acquire professional skills than the salary.

This paper has presented a model that furthermore enables a rigorous analysis of the invention and evolution of production technologies for internal goods more generally and their welfare implications. For example it is the first model that enable us to give the widely used concept of cultural capital a precise analytical definition. Cultural capital is the set of technologies for the production of internal goods that has been invented within a culture over the years and the skills that enable us to use those technologies. This does not only apply to dance, music and sports, but to all cultural endeavours including writing and acting. For example Oscar Wilde used humour, which is a technology, and his wit, which is a skill, to make us laugh, which is an internal good. Hence the theory of hobby human capital (or human capital intensive

technologies for consumption) does not only shed new light on old phenomena, like wage inequality and its persistence across generations, but also enables the modelling of several phenomena that have not been modelled before, such as the evolution of music and the professionalisation of hobbies. Other areas that the model brings additional insights into include, growth, happiness, social capital, habits and endogenous preferences, culture, entertainment, recreation and the market for education.

Hobbies are part of the informal economy, and do have an impact on the happiness of individuals, as well as enabling a natural venue for the building of social capital since you trust the people you for example play tennis with. Hence, it is an example of economic well being that is not fully part of the official statistics. Since the production of internal goods is an important source to happiness, the prediction would be that there should be a better correlation between wealth and happiness if the production of these goods were included in the figures.[20]

The hobby model provides a mechanism that explains why cultural capital matters for economic growth. If the production of internal goods can be enhanced by market goods, such as music, cultural capital and economic growth will synergise, whereas if the cultural capital is a substitute for market goods, the result of growth is that the old culture will be replaced by consumption. The replacement effect in turn implies that the incentives to acquire professional skills (which makes the economy grow) will be weaker, which can explain differences in growth patterns across countries. Hence, the prediction of the model is that phenomena such as the evolution of the western classical music were favourable to economic growth, since music and market goods are complementary in the production of utility.

Hobby human capital also provides an underlying mechanisms for why the consumption of certain goods may be 'addictive' even if the goods themselves are not.

[20]The fact that household production does not enter official statistics was made by Gronau (1980). This paper shows that there is an additional class of goods that should ideally be included.

If the consumption of the goods also involves acquiring human capital, for example when consuming art the individual also becomes more knowledgable about art, which increases the marginal utility of consuming art in the future, since the appreciation of art is an internal good which is produced using human capital and the art object. The production of internal goods can thus explain why individuals study subjects such as art history and acquire human capital that does not translate into higher future earnings, but as this example illustrates translates into higher marginal utility from the consumption of certain goods. Hence hobby human capital also plays an important role in Becker's (1992) theory of habits and his theory of endogenous preferences (Becker 1996), and adds to his theory about the incentives to acquire human capital (Becker 1993).

The application to the evolution of culture, entertainment and education, involve an understanding of the underlying mechanisms behind the professionalisation of hobbies. This involves two extensions of the model. One is the fact that not only do we derive utility from being able to dance ourselves, but we also derive utility from watching those who do it really well. Hence, part of the internal good is indeed transferable. The second is that whilst the personal internal good itself may be partly non-transferable the technology is not. Hence, there will be a market for the technologies that enable individuals to produce internal goods. Thus there will be a demand for some individuals to specialise in acquiring hobby skills for two reasons, to entertain and to educate.

In some cases this technology is human to human, like dance, in which case the cultural capital is labour intensive to maintain. In other cases like music, the invention of sheet music greatly reduced the cost of transferring the technology for the production of music. This was therefore an important factor in the evolution of music as an art form. When applied to these issues, the hobby model can provide insights that are relevant for cultural policy. For example, is there a reason why various art

forms should be subsidised or not? If there are distortions, what is their nature, and in which way do they differ from distortions in the markets for external goods?[21]

One important reason for why distortions may differ for internal and external goods is due to that it is the technology for the production that is being traded in the first case, whereas the good is being traded in the latter case. The main implication of this is that the consumer controls the quality of the output through his/her hobby skills. This has interesting implications for the pricing strategies for selling the technology, for example golf lessons, the price for using practice facilities, and finally the price for using the golf course. How will pricing strategies in the hobby industry vary depending on how much of the production process of the hobby good that it controls? For example will there be a difference in charges for dance lessons, where practicing and execution is free, and tennis where practicing and execution is costly by its nature. What is the economic rationale for having membership fees, and free lessons to tennis clubs rather than charging per unit of time, whilst dance lessons are typically charged per lesson and usually in the form of a course? Since the value of membership depends on the quality of the experience, the quality depends on the skills, and the skills are enhanced by practising, the skills will be maximised if the marginal cost of using the facilities is zero.

The hobby model is also useful in understanding the development of market goods to match the skills. For example the piano and Chopin's Etudes were created in response to more and more skilled pianists. As was shown in this paper, since the piano is a free hobby once the instrument has been purchased, the incentives to invest in such skills would have been strongest by professionals who had wealth, which certainly was a feature of the bourgeoise during the 1900th century. Hence,

[21] An interesting contribution in this area is Hoff and Lyon (1995). They consider the link between education and labour-leisure, choice, and argue that taxation that finances education creates more benefits than the cost in terms of distorted incentives later on.

it was no accident that the height of the piano's technical development coincided with the bourgeoise emerging as a more prominent class in society. Hence, there are several interesting extensions of the model that would provide more insights into the economic origins of our cultural capital.

This paper has shown that just as the existence and evolution of an economy was driven by a desire to enhance the production and consumption of external goods, the existence and evolution of culture was driven by the same desire to enhance the production and consumption of internal goods. Humans produce and consume both internal and external goods which makes the interaction between the formal economy and culture a fascinating field for further exploration. The model presented in this paper has furthermore shown how this can be done within the standard framework for economic analysis.

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