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ABSTRACT

Practice Makes Perfect: On Professional Standards

Professional standards vary across professions and also change over time. One profession which has remained perfectionist is classical music, where the amount of practising is striking compared with other professions.

Practising is a matter of increasing the reliability of ones skills rather than relying on a tool or a strike of genius to get it right. Once perfection has been achieved the individual will aim for higher quality since the effort is more likely to be worthwhile. Because the returns from perfection are higher the harder it is, the perfectionist equilibrium only arises in situations where genius is rare and reliability is low. As tools improve, even though perfection has become easier to achieve, professional standards may nonetheless decline. This mechanism is captured in an oligopoly model, where the failure rate and the quality are endogenously determined. It is shown that whilst individuals might be better off not playing a perfectionist equilibrium when reliability is low, welfare is higher in the perfectionist equilibrium than an enthusiastic equilibrium. Furthermore, when reliability is high individuals will play an enthusiastic equilibrium even though welfare and profits would be higher if they were perfectionists.

JEL Classification: D2, D43, J24, L13 and L15
Keywords: cultural economics, human capital, imperfect competition, learning, patent race, quality, skill, standards and technological change

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I Introduction

'errare humane est'

It is human to err, but as every aspiring musician knows successful practice makes perfect.[1] However, as every young economist knows, there is an opportunity cost of time. Is it optimal to aim for perfection? A musician would answer that there is no choice, since perfection is the standard that is expected and furthermore unless you have reliable skills it is quite risky to attempt learning to play the repertoire that is expected.

Classical music is but one example of a profession which is characterised by perfection and very high quality of the good that is produced.[2] This paper presents a highly stylized model with both normative and positive results. On the positive side it explains why

- it is when perfection is very hard to achieve that we tend to observe it in combination with very high quality, for example in conservation, music, and ballet;[3]
- professional standards may fall when improved tools become available, for example computers and the presence of typos, or power drills and skew screws;[4]

[1]To practice need not necessarily be a successful endeavour. Spending hours playing scales without the right articulation will achieve nothing and might even be damaging.

[2]Quality and professional standards are being used interchangeably throughout the paper.

[3]These professions are often also characterised by the superstar phenomenon (Rosen 1981).

[4]New technology does sometimes result in a reduction in quality of the goods produced (Chamberlin 1953). One reason for this is that new more efficient technology makes it optimal to serve consumers with lower marginal willingness to pay for quality (Sällström 1999).

- some highly skilled professions may die out when the opportunity cost of time goes up.

On the normative side the paper addresses whether there is too much or too little practice and perfection in equilibrium.

From an individual point of view there may be too much or too little practice depending on which equilibrium prevails. If individuals do not expect others to practice, the equilibrium professional standards will be low, and the returns to practising will be small. In this case there will be too little practice in equilibrium if the returns to quality are high. Conversely, if individuals expect everybody else to be perfectionists professional standards will be higher making practising worthwhile. In this case there will be too much practice in equilibrium if returns to quality are not very high. The fact that private incentives are distorted implies that since the welfare gains from practising and perfection are strictly higher than the private returns, there could be an optimal level or even too little practising in equilibrium.

If individuals do practice, welfare is strictly higher if they are perfectionists who only produce the good if they succeeded in making their skills more reliable. Individuals in contrast, would be better off in equilibrium if they attempted to meet the standards even if they failed in improving the reliability of their skills when tasks are difficult. But since it is then costly being an enthusiast there will be a perfectionist equilibrium. Conversely, when tasks are relatively easy the private returns would be higher if individuals were perfectionists, however in this case the individual will not be able to resist the temptation to give it a go even if they do not have reliable skills, and therefore end up with a lower payoff in an enthusiastic equilibrium where professional standards are lower.

The intuition for the positive results is as follows.

If there are professionals around with reliable skills, you will have to match the professional standards they set if you wish to compete with them. If the chances are small an individual can manage without reliable skills, it will be optimal for the individual to aim for perfection as well and only compete if successful in achieving it. Furthermore if perfectionists only expect there to be competition from others who managed to achieve perfection, they will aim for higher professional standards than they would in a situation where there are enthusiasts around giving it a go even if they do not have the skills that enable perfection.

When improved tools become available the profession may change from a perfectionist equilibrium to a lazy equilibrium in which nobody aims for perfection and instead relies on the tools to get it right. Even though the tool has made it easier to achieve perfection, by being a substitute for skills it has weakened the incentive to acquire the skills. As a result professional standards may fall. An illustrative example is the number of typos in printed books compared with say fifty years ago, where individuals rely on computer software rather than acquiring the skill of typewriting and proof reading.

When the opportunity cost of time increases, the perfectionist equilibrium may cease to exist when genius is rare and reliability is low. Examples of this effect can be found for some highly skilled crafts, where unless reliable skills are acquired it is not worthwhile even trying. Hence, if nobody has invested the time to achieve perfection, there will be no one out there who can do it any more.

These effects arise when the accumulation of human capital and the production process both entail an element of risk that the effort will not materialise into the intended outcome, which is a characteristic feature of creative industries (Caves 2003). Spending hours practising is a way of trying to eliminate this risk in making ones skills more reliable. However, spending hours practising is risky as well since there is no guarantee the individual will be successful in achieving perfection despite the practice. In some cases it will also take longer to realise you are not going to make it, than in other cases. For example it takes ten years to learn to play the piano. But unless you spend the time you will never learn whether practice would have helped. Anyone is allowed to try to meet the standards of the profession, but those who have practised and been successful in increasing their reliability are more likely to succeed in meeting any standards and will therefore have incentives to aim for higher quality.

The game between for example two aspiring musicians, is modelled as a patent race[5] between two independent producers with three important additions. First, there is a risky option to accumulate human capital[6], which if successful will eliminate the risk of the production process. Second, the quality of the output is endogenised too. It is chosen after the individual has had the opportunity to try to improve the reliability of the production process, but before the individual learns about his competitors achievements or failures. Third, the risk depends both on strike of genius and reliability of skills. The less reliable the more time it takes before perfection can be achieved if ever. Those who have been successful in meeting the same professional standards then compete a la Cournot.

Perfectionism is an important element in the history of moral thought from Plato and Aristotle through Spinoza and Hegel, the Aristotelian thesis being that 'developing human nature fulfils our function or purpose as humans'. The perfection considered in this paper is a combination of the human excellences : physical perfection, theoretical rationality and practical rationality (Hurka 1993). Since in most professions skills that make a process more reliable will be a combination of the physical, intellectual and practical capabilities of a human being. It is precisely because either of these may be limiting that individuals can not be certain of achieving perfection even if they try.

I am not aware of any formal model which addresses the problem of risky human capital and its relation to risky technology and quality of output. It is, however, very prevalent in creative industries, and is one of the factors which makes these industries distinct from other industries. In an excellent review article on contracts

[5] In a patent race there are two firms who invest resource in research and development which may or may not result in a product. The outcome of this process is that the firm will either find itself having nothing to sell, be in a monopoly position, or be in a duopoly position (Reinganum's 1989).

[6] The model assumes investments in human capital of this sort have a positive effect on productivity. Using unique data from the National Center on Education Quality of the Workforce it was shown that there are productivity gains from human capital investments (Black and Lynch 1996).

between art and commerce (Caves 2003) it was noted that this is an area in great need of analytical models. The only models that have been done so far have been related to the nature of the contracts. This paper therefore fits in nicely by looking at one of the sunk costs that has only been addressed verbally so far. The model in this paper also has wider applicability since the parameter in the model that in the case of artistic professions represents genius, would in other professions represent the reliability of the tools. Since genius is a gift of nature, whereas tools can be improved, the model furthermore explains why perfection has remained an equilibrium in for example classical music, but ceased to be in for example the building industry.

The outline of the paper is as follows. The model is outlined in section II followed by an analysis of professional standards. In this section more detailed results are presented for how quality depends on expectations about strategies played by others, and how genius and reliability influence the level. In Section III I characterise and derive conditions under which the perfectionist, enthusiastic and lazy equilibrium will exist. This section also contains a numerical example of the effect of improved tools on professional standards and the equilibrium. Section IV evaluates to what extent individual incentives are distorted in relation to welfare and prive returns. The paper concludes with a discussion of the assumptions in Section V.

II The Model

Consider two individuals who are making decisions about how to prepare themselves for and whether to pursue a career in for example music.

Let γ be the probability that the effort results in the intended outcome. It depends on the prior probability that you can rely on a tool or genius to get it right α,[7] and

[7] The parameter α measures the relative importance of tools or genius, versus skills in getting it right. Hence, with a self-correcting tool, α would be high. For example if your word processor automatically corrects for typos, being a skillful typist has lower returns.

when genius does not strike the reliability *ex ante* $\beta \in [0, 1]$.[8] The prior probability that putting in the effort will be worthwhile is

$$\gamma = \alpha + (1 - \alpha)\beta. \tag{1}$$

The timing of the game is as follows. The first choice the individual has to make is whether or not to try to achieve perfection by practising and putting in the effort required to fill the gap, $e = 1 - \beta$. The chances of being successful in this endeavour are γ, and the cost of the effort is ke^2. The posterior reliability if the individual attempts to achieve perfection by putting in effort $e_1 = 1 - \beta$ is,

$$\gamma_1 = \begin{cases} 1 & \text{if success,} \\ \beta & \text{if failure.} \end{cases} \tag{2}$$

If an individual is successful in achieving perfection she knows she can rely on her skills to a hundred percent. Her posterior probability of a strike of genius is $\alpha_1 = \frac{\alpha}{\alpha + (1-\alpha)\beta}$. However, since the reliability of her skills is $\beta + e_1 = 1$ this no longer matters. If she fails to improve the reliability of her skills despite having practised, she has learnt she is definitely not a genius or that she cannot rely on her tools to get it right, that is the posterior probability of genius is $\alpha_1 = 0$, but that she still can succeed with probability β in successfully completing the task.

The second choice is whether or not to pursue a career and if yes what quality s to aim for. Up until this point all actions and outcomes remain private information. If the individual puts in effort $e_2 = s$ it will materialise in s with probability γ_1. If the individual is successful in achieving s, it becomes public information, that is once you are ready to give a concert your competitors will know it. At this stage those who have been successful in achieving the same standard s compete a la Cournot, that is, decide on how many concert tickets to make available.

Since there are only two players, for analytical convenience, someone who has been successful in learning to play for example Rachmaninov's second piano concerto, will

[8]Note that β also is a measure of how hard it is to achieve perfection. The smaller is β the harder it is.

either be in a monopoly position or in a duopoly position. If the demand for quality takes the standard form (Mussa and Rosen 1978; Gabszewicz and Thisse 1979), that is $U = V\theta s - p$, with the taste parameter θ uniformly distributed on $[0, 1]$, the maximised revenue for the monopoly and duopoly cases can be written as follows,[9]

$$R^M = \frac{Vs}{4}, \tag{3}$$

$$R^D = \frac{Vs}{9}, \tag{4}$$

where V reflects the returns to quality in the market. For these standard preferences the revenue will be linear in quality of the good or service provided.

The expected payoff when choosing the professional standard s depends on expectations about the strategy employed by the other player.

There are three possible strategies.

1. **L**azy, no practice, relies on genius and good luck in pursuing the career.

2. **P**erfectionist, practices hard and will only pursue a career if perfection is achieved.

3. **E**nthusiast, practices hard and pursues the career regardless.

The probability of facing competition in the final period is γ if the other player plays L or P and $\gamma + (1 - \gamma)\beta$ if the other one plays E. Hence, the expected payoff if successful in delivering s is

$$\gamma\frac{Vs}{9} + (1 - \gamma)\frac{Vs}{4} = \frac{9 - 5\gamma}{36}Vs \tag{5}$$

if the other player is lazy or a perfectionist, and

$$(\gamma + (1 - \gamma)\beta)\frac{Vs}{9} + (1 - \gamma)(1 - \beta)\frac{Vs}{4} = \frac{9 - 5(\gamma + (1 - \gamma)\beta)}{36}Vs \tag{6}$$

if the other player is an enthusiast.

[9] In this case the revenue from a concert will be maximized for $\max_\theta V\theta s(1 - \theta)$ which gives revenues $R^M = \frac{Vs}{4}$, and so on.

II.1 Professional standards

The professional standards, that is the quality that is expected, are those that would be chosen by someone who has reliable skills unless nobody is expected to have reliable skills in equilibrium in which case the 'lazy' sets the standard.

An individual with reliable skills will choose the quality to maximise the expected payoff. Note that since reliable skills means that there is no risk that these standards will not be met, the individual maximises

$$s_P = \arg\max \left(\frac{9-5\gamma}{36}\right) V s_P - k s_P^2 \tag{7}$$

if she expects the competitors to be either lazy or perfectionists. The optimal standard in this case is

$$s_P^* = \frac{9-5\gamma}{36}\frac{V}{2k}, \tag{8}$$

taking the first derivative with respect to α gives

$$\frac{\partial s_P}{\partial \alpha} = -\frac{5(1-\beta)}{36}\frac{V}{2k} \tag{9}$$

which is negative. The first derivative with respect to β is

$$\frac{\partial s_P}{\partial \beta} = -\frac{5(1-\alpha)}{36}\frac{V}{2k} \tag{10}$$

which is also negative. The professional standards will be higher the harder it is to achieve due to genius being rare and/or the task being intrinsically difficult, since it is then more likely that the individual who has achieved perfection will be unique. There is no positive effect from neither α nor β, since once perfection has been achieved, their only role is to determine to what extent others might have been able to achieve the same. The reliability β influences the cost of practising, but this is a sunk cost and will therefore not matter for the quality later on. Similarly genius α will increase the chances that the individual will achieve perfection, but once perfection has been achieved, it becomes irrelevant, since with reliable skills the individual no longer has to rely on a strike of genius to get it right.

If the individual expects competition from an enthusiast, she chooses

$$s_E = \arg\max \frac{9 - 5(\gamma + (1-\gamma)\beta)}{36} V s_E - k s_E^2. \tag{11}$$

The optimal standard in this case is

$$s_E^* = \frac{9 - 5(\gamma + (1-\gamma)\beta)}{36} \frac{V}{2k}, \tag{12}$$

which is less than when faced with competition from a perfectionist. If faced with competition from someone who will give it a go, regardless of whether they have reliable skills to meet the quality standards, it is optimal for someone who has reliable skills to set lower standards. This is because it is more likely she would be faced with competition, and therefore returns to quality will be lower.

Since $(\gamma + (1-\gamma)\beta) = \alpha + (1-\alpha)\beta(2-\beta)$, the first derivative with respect to α can be written,

$$\frac{\partial s_E}{\partial \alpha} = -\frac{5(1 - \beta(2-\beta))}{36} \frac{V}{2k}. \tag{13}$$

It will be negative but smaller in magnitude than if the individual expected competition from a perfectionist. The first derivative with respect to β is

$$\frac{\partial s_E}{\partial \beta} = -\frac{5(1-\alpha)2(1-\beta)}{36} \frac{V}{2k}. \tag{14}$$

Again the effect is negative, but in this case it is larger in magnitude than when competition is expected from a perfectionist.

The increased chance that others may have genius as well has a greater negative effect on quality when the individual expects competition from a perfectionist (or a lazy individual) than when she expects competition from an enthusiast. Whereas, the task being more difficult (lower β) has a greater positive effect on quality if the individual expects competition from an enthusiast, than from a perfectionist. This is because there is an additional effect from β if the individual expects competition from an enthusiast, since β is also the posterior probability γ_1 for those who failed and thus the likelihood they will show up at the final stage.

In an equilibrium where everybody plays the lazy strategy and expects everybody else to play the lazy strategy as well, the professional standards solve

$$s_L = \arg\max \gamma \left(\frac{9-5\gamma}{36}\right) V s_L - k s_L^2. \tag{15}$$

The professional standards when nobody attempts to achieve perfection will be

$$s_L^* = \gamma \frac{9-5\gamma}{36} \frac{V}{2k} = \gamma s_P^*. \tag{16}$$

The fact that an individual who employs a lazy strategy will only be successful in delivering s with probability γ if he puts in an effort $e_2 = s$, implies he will not aim as high as an individual with reliable skills would have done.

The first derivative with respect to γ is

$$\frac{\partial s_L^*}{\partial \gamma} = \frac{9-10\gamma}{36} \frac{V}{2k}. \tag{17}$$

The lazy standard is increasing in α and β reaching a maximum at $\gamma = \frac{9}{10}$, and decreases thereafter. Hence, it is only when the chances of succeeding are very high that the standards start falling for an even higher γ. This is because there are two effects. The first one is that a higher γ implies it is more likely the effort will be worthwhile which has a positive effect on quality. The second is that a higher γ implies that it is more likely other people will have been successful as well, which has a negative effect.

The professional standards converge as $\gamma \to 1$. A higher γ implies that there is less to be gained from becoming a perfectionist relative to those who are not, and furthermore it is less likely that one would be able to enjoy a monopoly position if successful.

It is noteworthy that an individual who has achieved perfection will aim for lower professional standards if she expects the other player to be an enthusiast rather than lazy or a perfectionist. The reason for this is that both the perfectionist and a lazy person are less likely to show up and compete in the final period than the enthusiast.

Note that since, $s_L = \gamma s_P$, it is easily verified that the standards in a lazy equilibrium are strictly less than those that an individual with reliable skills would set. The question is whether the professional standards when there are enthusiasts around are ever going to be lower than the standards that will be chosen when everybody is lazy. Does $s_E > s_L$ always hold or does it depend on parameter values? It holds if

$$\frac{9-5(\gamma+(1-\gamma)\beta)}{36}\frac{V}{2k} > \gamma\frac{9-5\gamma}{36}\frac{V}{2k}. \tag{18}$$

Simplifying and collecting terms

$$(1-\gamma)(9-5\gamma) > 5(1-\gamma)\beta \tag{19}$$

substituting for $\gamma = \alpha + (1-\alpha)\beta$ we get

$$\alpha(1-\beta) + 2\beta < \frac{9}{5} \tag{20}$$

which is not satisfied for β close to one. When perfection in skills makes a very little difference, quality will be higher in a lazy equilibrium than in an enthusiastic equilibrium. In the enthusiastic equilibrium people have on average more reliable skills, but they also face more competition, and the latter effect dominates when β is high.

Another interesting observation is how the difference in standards between the perfectionist equilibrium and the enthusiastic equilibrium varies with α and β,

$$s_P - s_E = \frac{5(1-\gamma)\beta}{36}\frac{V}{2k} = \frac{5(1-\alpha)(1-\beta)\beta}{36}\frac{V}{2k}. \tag{21}$$

The difference is decreasing in α, whereas for $\beta < \frac{1}{2}$ it is increasing and for $\beta > 1/2$ it is decreasing, reaching a maximum for $\beta = 1/2$. When β is very small there is hardly any difference in level of competition in the final period for the two strategies, and standards will therefore be very similar. If β is very high, it is not very likely an enthusiast would fail, and therefore it makes very little difference that he would give it a go even if he failed. It is when β is in the intermediate range, that the difference is most marked.

To sum up. Quality is the highest and will be delivered with certainty if everybody is a perfectionist. When individuals are enthusiasts, the quality will be slightly lower, and there is a chance it will not be delivered. Quality is the lowest, and the failure rate the highest when individuals are lazy, unless genius is very common and/or tasks are easy, in which case quality will be higher than in the enthusiastic equilibrium. However, reliability will still be lower.

Thus the quality, as well as the reliability with which it is delivered will depend on which strategies are employed in equilibrium.

III Pure Strategy Equilibria

There are three possible symmetric pure strategy equilibria in the model. In this section I analyse their properties and conditions under which they will exist.

III.1 Perfectionist

In the perfectionist equilibrium individuals aim for perfection and only pursue their careers if they achieve perfection. The equilibrium standards are

$$s_P = \frac{9-5\gamma}{36}\frac{V}{2k}, \tag{22}$$

with equilibrium payoff

$$\Pi^*(P,P) = \gamma\left(\frac{9-5\gamma}{36}\right)^2\frac{V^2}{4k} - k(1-\beta)^2 = k\left(\gamma s_P^2 - (1-\beta)^2\right). \tag{23}$$

The first γ is the probability that the individual will succeed in achieving perfection in which case she will also succeed in delivering a good of quality s_P with probability one. However, the cost of practising $k(1-\beta)^2$ will be incurred regardless. The equilibrium payoff is positive if,

$$s_P^2 > \frac{(1-\beta)^2}{\gamma}. \tag{24}$$

This condition will be satisfied as long as the returns to quality V are sufficiently high relative to the opportunity cost of time k. Hence, if k increases at a higher rate than V this condition may no longer be satisfied. This is precisely the problem faced in some highly skilled crafts where the higher opportunity cost of time has not been matched by a corresponding increase in the returns to quality, implying that the expected payoff from a perfectionist strategy is negative.

The next question is how does the profit vary with genius and difficulty of the task? Taking the first derivative of the equilibrium profit with respect to α gives

$$\frac{\partial \Pi}{\partial \alpha} = k s_P \left[(1-\beta) s_P + \gamma 2 \frac{\partial s_P}{\partial \alpha} \right] \tag{25}$$

$$= \frac{(1-\beta)V}{72} s_P \left[9 - 15\gamma \right]. \tag{26}$$

The profit will be increasing in α as long as $\gamma < \frac{9}{15}$. After that it will be decreasing. There are two effects from genius. The first is that it increases the chances of being able to achieve perfection, which has a positive effect. The second is that it also increases the chance somebody else will have achieved perfection as well, thus competition becaomes more likely which has a negative effect. For α sufficiently small the first effect dominates. Similarly

$$\frac{\partial \Pi}{\partial \beta} = k \left[(1-\beta) s_P^2 + \gamma 2 s_P \frac{\partial s_P}{\partial \beta} + 2(1-\beta) \right] \tag{27}$$

$$= \frac{(1-\alpha)V}{72} s_P \left[9 - 15\gamma \right] + 2k(1-\beta). \tag{28}$$

Since β plays two roles, there will be an additional positive effect since a higher β lowers the effort needed to achieve perfection.

Perfection is an equilibrium if it is neither profitable to deviate by employing the enthusiastic strategy nor the lazy one if the individual expects the standards to be those of a perfectionist equilibrium.

First, an individual who tried but failed in the first period should not wish to continue in the second period,

$$\beta \left(\frac{9-5\gamma}{36} V s_P \right) - k s_P^2 < 0. \tag{29}$$

This can be written

$$(2\beta - 1) k s_P^2 < 0. \tag{30}$$

The enthusiastic strategy would result in a negative payoff if the standards are those of a perfectionist equilibrium if $\beta < 1/2$. Thus if the task is sufficiently difficult there is no incentive to deviate in period two. A player who plays the enthusiastic strategy is better informed about his true chances to succeed in delivering s, than someone who plays the lazy. If he succeeded he will get a higher payoff than a lazy, whereas if he failed his expected payoff will be lower. Hence, a lazy individual is more likely to give it a go than an enthusiast who failed.

Second, trying to achieve s_P with no practice should result in a lower expected payoff than playing the perfectionist strategy. The payoff from the lazy strategy if the other player plays the perfectionist strategy is

$$\Pi(LP) = \gamma \left(\frac{9 - 5\gamma}{36} \right) V s_P - k s_P^2 = (2\gamma - 1) k s_P^2. \tag{31}$$

Since this strategy gives a negative payoff for $\gamma < 1/2$, there is no incentive to deviate by being lazy when genius is rare and reliability is low. To see this one can solve for β which gives

$$\beta < \left[\frac{1}{2} - \alpha \right] \frac{1}{1 - \alpha}. \tag{32}$$

It can be confirmed that this is indeed a more stringent condition on β than (30), since the right hand side is less than $1/2$ for $\alpha > 0$. Here we see that it is when genius is rare, that is α is small, that there is no incentive whatsoever for an individual to play the lazy strategy, provided that the task is sufficiently difficult, that is β is small too.

Furthermore the enthusiastic strategy does not only give less in expectation from the point of view of period two, but also from the point of view of the entire game. Comparing the expected payoff $\Pi(EP) < \Pi(LP)$ one gets

$$(2\beta - 1) k s_P^2 < (2\gamma - 1) k s_P^2. \tag{33}$$

If there is no incentive to deviate by being lazy, there certainly will not be an incentive to deviate by being an enthusiast either.

Condition (32) is a sufficient condition for there to be a perfectionist equilibrium. A necessary condition is that $\Pi(PP) > \Pi(LP)$, that is

$$\gamma k s_P^2 - k(1 - \beta)^2 > (2\gamma - 1) k s_P^2 \tag{34}$$

Since $1 - \gamma = (1 - \alpha)(1 - \beta)$ this condition can be written

$$s_P^2 > \frac{1 - \beta}{1 - \alpha} \tag{35}$$

that is the perfectionist equilibrium quality has to be higher than the ratio of difficulty of the task $(1 - \beta)$ to how much the individual relies on having reliable skills $(1 - \alpha)$. The left hand side is decreasing in α and β whereas the right hand side is increasing in α and decreasing in β. If α goes up the condition is less likely to be satisfied, whereas if β goes up the effect is ambiguous. A higher α implies that the relative importance of having reliable skills decreases and the incentives to acquire those skills are therefore weakened. For example, having type writing skills become relatively less important when the individual no longer has to use a typewriter but can rely on computer software. Perfection on the other hand is a strategy that arises in situations where it is not very likely you will get it right unless you have reliable skills such as in classical music where both α and β are small.

Finally the individual should not get a higher payoff by doing nothing, that is the equilibrium payoff has to be positive for it to be an equilibrium. On this account comparing (29) and (35) reveals that if genius is rare

$$\alpha < \frac{1 - 2\beta}{2(1 - \beta)}, \tag{36}$$

it will not be profitable to deviate by being lazy when the payoff in the perfectionist equilibrium is positive. It should be noted that this is the same condition as (32). Thus when genius is rare and perfection is difficult to achieve, there will be a perfectionist equilibrium if the expected payoff in equilibrium is positive.

Condition (35) can also be rewritten in a form that is intuitively appealing, namely

$$\gamma < 1 - \left(\frac{e_1}{s_P}\right)^2. \tag{37}$$

The probability of succeeding has to be smaller than one minus the ratio of first to second period effort squared. If the effort required to achieve perfection is higher than the effort required to meet the professional standards, this condition can not be satisfied for any γ. Hence it is a necessary condition that effort increases over time, $e_1 < e_2$, for $e_2 = s_P$.

The higher the standards the greater the effort needed to meet them, and hence the more valuable it is to be able to do so reliably. However, if the effort required to make them reliable is more that the effort required to meet them, there is not point in practising.

In terms of parameters one can be even more precise. It is required that

$$1 - \beta < \frac{9 - 5\gamma}{36} \frac{V}{2k}. \tag{38}$$

If the returns to quality versus opportunity cost of time, that is the ratio between the parameters V and k, is high enough, $\frac{V}{k} > \frac{72}{5}$, we have the following result. If

$$\alpha > 1 - \frac{72k}{5V} \tag{39}$$

the effort will increase if β is high enough, since (38) can then be written

$$\beta > \frac{72k - V(9 - 5\alpha)}{72k - 5V(1 - \alpha)}. \tag{40}$$

Note that the right hand side is less than one. Whereas for

$$\alpha < 1 - \frac{72k}{5V} \tag{41}$$

the effort will increase if

$$\beta < \frac{V(9 - 5\alpha) - 72k}{5V(1 - \alpha) - 72k} \tag{42}$$

which is trivially satisfied since the right hand side is greater than one.

If α is high, β has to be high enough for effort to increase over time. Whereas if α is small, effort will increase over time regardless of β. These results occur when the marginal returns to quality V are high enough relative to the opportunity cost of time k.

When α is small, skills are relatively more important, and individuals will therefore have an incentive to try to improve the reliability of their skills by practising. Whether or not they employ a perfectionist or an enthusiastic strategy if they practice depends entirely on the difficulty of the task as we shall see when we consider the conditions under which the enthusiastic equilibrium will arise.

III.2 Enthusiast

If there is an enthusiastic equilibrium everybody practices to make their skills reliable Those who succeed set the standard expecting competition also from those who failed to make their skills more reliable.

The equilibrium standard is

$$s_E = \left(\frac{9 - 5(\gamma + (1-\gamma)\beta)}{36}\right)\frac{V}{2k} \tag{43}$$

with expected equilibrium payoff

$$\begin{aligned} \Pi^*(E,E) &= (\gamma + (1-\gamma)\beta)\left(\frac{9 - 5(\gamma + (1-\gamma)\beta)}{36}\right)^2 \frac{V^2}{4k} - k(1-\beta)^2 & (44) \\ &= k\left[(\gamma + (1-\gamma)\beta)s_E^2 - (1-\beta)^2\right]. & (45) \end{aligned}$$

This payoff is positive if

$$s_E^2 > \frac{(1-\beta)^2}{\alpha + (1-\alpha)\beta(2-\beta)}. \tag{46}$$

Taking the first derivative with respect to α gives

$$\frac{\partial \Pi_E}{\partial \alpha} = \frac{(1-\beta)^2 V}{72} s_E \left[9 - 30(\gamma + (1-\gamma)\beta)\right]. \tag{47}$$

There is the same trade off as in the perfectionist equilibrium, however, the competitive effect will dominate earlier, since there is more competition in the enthusiastic equilibrium. Similarly for β one gets

$$\frac{\partial \Pi_E}{\partial \beta} = \frac{(1-\beta)(1-\alpha)V}{36} s_E \left[9 - 15(\gamma + (1-\gamma)\beta)\right] + 2k(1-\beta). \tag{48}$$

The enthusiastic strategy is an equilibrium if it is optimal to stay in for someone who attempted to achieve perfection but failed. The expected payoff from someone who attempted but failed is

$$\beta\left(\frac{9 - 5(\gamma + (1-\gamma)\beta)}{36}\right)^2 \frac{V^2}{2k} - k s_E^2 > 0. \tag{49}$$

This is positive if $\beta > 1/2$. Hence, whether there is an enthusiastic or a perfectionist equilibrium depends on whether β is less than or greater than $1/2$.

Furthermore, it should not be possible for a lazy individual to get a higher payoff in this equilibrium. The payoff to a lazy individual is,

$$\gamma \left(\frac{9 - 5(\gamma + (1-\gamma)\beta)}{36} \right)^2 \frac{V^2}{2k} - ks_E^2 = (2\gamma - 1)ks_E^2. \tag{50}$$

This payoff will be positive for $\beta > 1/2$, since this implies $\gamma > 1/2$. Hence we need to compare it with the expected payoff from the enthusiastic strategy,

$$(\gamma + (1-\gamma)\beta)ks_E^2 - k(1-\beta)^2 > (2\gamma - 1)ks_E^2 \tag{51}$$

this equivalent to

$$(1-\gamma)(1+\beta)ks_E^2 > k(1-\beta)^2 \tag{52}$$

which can be written,

$$s_E^2 > \frac{1-\beta}{(1-\alpha)(1+\beta)}. \tag{53}$$

This condition is interesting. The left hand side is decreasing in α and β, whereas the right hand side is decreasing in β but increasing in α. Hence, the condition is more likely to be satisfied if α is small, since the professional standards are then going to be higher. Hence the enthusiastic equilibrium is more likely to arise when genius is rare and tasks are not too difficult.

If condition (53) is satisfied, the individual will also enjoy a positive payoff in equilibrium. We can see this by noting that

$$\frac{1-\beta}{(1-\alpha)(1+\beta)} > \frac{(1-\beta)^2}{\alpha + (1-\alpha)\beta(2-\beta)} \tag{54}$$

which can be simplified to $\alpha + (2\beta - 1)(1-\alpha)$ hence it is trivially satisfied for $\beta > \frac{1}{2}$. This implies that there are instances where the expected revenue in the enthusiastic equilibrium is higher than the cost of practising, but it is not sufficient for it to be an equilibrium. This stands in sharp contrast to the perfectionist equilibrium which under conditions when genius is rare and tasks are difficult will exist provided that the expected revenue is higher than the cost of practising.

When α is low we have a situation where skills are important to get it right. Depending on how reliable those skills are ex ante there will be a perfectionist equilibrium if reliability is low, such as in classical music, and an enthusiastic equilibrium when reliability is medium to high.

Furthermore if α is high, professional standards will be lower in both the perfectionist and the enthusiastic equilibrium, which will make it less costly for a lazy individual to match those and give it a go without practising. Hence, there will then be an incentive to deviate by being lazy.

III.3 Lazy

Now, consider the lazy equilibrium where standards are set by a lazy individual who does not expect anyone to aim for perfection in their skills. In this case the professional standards are

$$s_L = \gamma \left(\frac{9 - 5\gamma}{36} \right) \frac{V}{2k} \tag{55}$$

which gives equilibrium payoff

$$\Pi^*(LL) = \gamma^2 \left(\frac{9 - 5\gamma}{36} \right)^2 \frac{V^2}{4k} = ks_L^2. \tag{56}$$

Here the expected payoff is always positive, since the standards are chosen to maximise this payoff and there is no cost of practising. Thus there is no sunk cost in this case. Furthermore it has the same maximum as s_L, that is it is increasing for α and β for $\gamma < 9/10$. It reaches a maximum later than the perfectionist equilibrium.

This is an equilibrium if neither the perfectionist nor the enthusiastic strategy would in expectation give a higher payoff. Hence, $\Pi(LL) > \Pi(PL)$,

$$ks_L^2 > \gamma \left(\frac{9 - 5\gamma}{36} V s_L - ks_L^2 \right) - k(1 - \beta)^2 \tag{57}$$

simplifying this gives

$$ks_L^2 > \gamma(2 - \gamma) s_L \frac{9 - 5\gamma}{36} \frac{V}{2} - k(1 - \beta)^2 \tag{58}$$

simplifying further

$$s_L^2 < \frac{1-\beta}{1-\alpha}. \tag{59}$$

the lower the professional standards that have to be met the lower the gains from being able to deliver reliably.[10]

The enthusiastic strategy will not give a higher expected payoff if $\Pi(LL) > \Pi(EL)$,

$$ks_L^2 > (\gamma + (1-\gamma)\beta)\left(\frac{9-5\gamma}{36}Vs_L\right) - ks_L^2 - k(1-\beta)^2 \tag{60}$$

simplifying

$$\frac{\gamma(1-\beta)}{2(1-\alpha)\beta} > s_L^2. \tag{61}$$

This is a less stringent condition than (59) if

$$\frac{\gamma(1-\beta)}{2(1-\alpha)\beta} > \frac{1-\beta}{1-\alpha} \tag{62}$$

simplifying

$$\alpha > \frac{\beta}{1-\beta}. \tag{63}$$

If α is high enough, then if it is not profitable for a perfectionist to deviate it will not be for an enthusiast either. The necessary condition is then (59) which can alternatively be written

$$\gamma > 1 - \left(\frac{e_1}{s_L}\right)^2. \tag{64}$$

This condition is trivially satisfied if the effort required to achieve perfection is higher than the effort required to meet the standards in the lazy equilibrium. If the reverse is true, it is required that γ is high enough. This is an intuitive result. If it is more costly to improve ones skills than just giving it a go, there are no incentives to practice. However, the higher the effort required to meet the professional standards relative to the effort required to achieve perfection, the higher the returns to being able to deliver reliably.

[10] Note that the professional standards define the quality that people expect. This has two implications. First, as long as it is met there will neither be any complaints nor any money back issues. Second, there will not be any rewards to doing more. Hence, if the lazy equilibrium prevails, a perfectionist has nothing to gain, other than his own self-esteem, aiming for more than s_L.

It should also be noted that since the professional standards differ between the lazy and the perfectionist equilibrium it is possible that

$$s_L^2 < \frac{1-\beta}{1-\alpha} < s_P^2. \tag{65}$$

If the individuals expects standards to be lazy, it will not be optimal to practice, whereas if the individual expects the standards to be the perfectinoist once it will be optimal to practice. In this case it will therefore depend on what people expect which equilibrium will prevail.

We shall conclude this section by looking at a numerical example to illustrate what happens when the relative importance of skills changes due to new improved tools.

Consider at first $\alpha = \beta = \frac{1}{4}$. For these parameter the standards in a perfectionist equilibrium would be

$$s_P(\frac{7}{16}) = \frac{109}{4^2 6^2} \cdot \frac{V}{2k}. \tag{66}$$

There exists a perfectionist equilibrium if (35) is satisfied, namely if

$$\left(\frac{109}{4^2 6^2} \cdot \frac{V}{2k}\right)^2 > 1. \tag{67}$$

This will be satisfied provided that V/k is high enough. Let $\Pi_i(\gamma)$ denote the equilibrium payoff in equilibrium i. Then

$$\Pi_P(\frac{7}{16}) = \frac{7}{16}\left(\frac{109}{4^2 6^2}\right)^2 \frac{V^2}{4k} - k\frac{9}{16} \tag{68}$$

Now suppose that the tools are improved so that $\alpha = \frac{1}{2}$, whereas β remains at $\frac{1}{4}$. Then the standards that would prevail in the two candidate equilibria would be

$$s_P(\frac{5}{8}) = \frac{47}{8 \cdot 6^2} \cdot \frac{V}{2k}, \tag{69}$$

$$s_L(\frac{5}{8}) = \frac{5}{8} \cdot \frac{47}{8 \cdot 6^2} \cdot \frac{V}{2k}. \tag{70}$$

The perfectionist equilibrium will no longer exist if (35) is no longer satisfied, that is

$$\left(\frac{94}{4^2 6^2}\frac{V}{2k}\right)^2 < \frac{3}{2}. \tag{71}$$

This will be satisfied provided that V/k is not too high. There will be a move from a perfectionist to a lazy equilibrium for a range of parameter values if the lower and upper bounds are compatible. The lower bound on V/k in (67) is less than the upper bound in (71) if

$$\left(\frac{94}{109}\right)^2 < \frac{3}{2}, \tag{72}$$

which is indeed satisfied.

The quality and reliability falls when we move from a perfectionist equilibrium to a lazy equilibrium due to an increase in α,

$$s_P(\frac{7}{16}) - s_L(\frac{5}{8}) = \left[\frac{4 \cdot 109 - 5 \cdot 47}{8^2 6^2}\right] \frac{V}{2k} > 0 \tag{73}$$

This is true in general since s_P is decreasing α. Thus for any $\alpha'' > \alpha'$ we have that $s_L(\alpha'') = \gamma s_P(\alpha'') < s_P(\alpha'') < s_P(\alpha')$.

Improved tools will result in lower professional standards regardless of whether the equilibrium changes from perfectionist to lazy or not. However, the reduction will be even larger and reliability, of those who try to produce the good, lower if there is a switch to a lazy equilibrium. However, the *a priori* chances the good will be delivered at all have increased from $\gamma = \frac{7}{16}$ to $\gamma = \frac{5}{8}$.

The expected equilibrium payoff in the lazy equilibrium is

$$\Pi_L(\frac{5}{8}) = \frac{25}{64}\left(\frac{47}{8 \cdot 6^2}\right)^2 \frac{V^2}{4k} \tag{74}$$

This payoff is higher than the individual got in the perfectionist equilibrium with a lower α. To see this note that if the expected payoff in the perfectionist equilibrium was higher, the following would have to be true.

$$\left(\frac{V}{k}\right)^2 > \frac{36(4^2 6^2)^2}{7(109)^2 - \frac{25}{4}(94)^2} \tag{75}$$

The right hand side exceeds the upper bound on V/k. Hence, the individual payoff cannot be higher in the perfectionist equilibrium if it changes to a lazy.

This example has illustrated that if the returns to quality relative to opportunity cost of time are high but not too high, a profession that used to be characterised by a perfectionist equilibrium may switch to a lazy equilibrium when tools improve.

Even though the chances of being successful in achieving perfection have improved, standards will fall. Thus when tools improve, such as typewriters being replaced by computers, the chances to succeed without reliable skills increase, which lowers the return to practising to make ones skills more reliable. As a result the professions may move from a perfectionist equilibrium, in which only those with type writing skills would prepare manuscripts to a lazy equilibrium in which everybody relies on the software to get it right. The result being that there are more typos in printed work, that is professional standards have fallen, but more people are actually doing it.

IV Welfare

The equilibrium analysis showed that when the relative importance of skills for success is high that is when α is small, the difficulty of the task will determine whether there is a perfectionist or an enthusiastic equilibrium. Furthermore when the task is difficult, $\beta < 1/2$, it depends on α whether there is a perfectionist equilibrium or not. The question is when, how and why private, collective and social incentives may differ in these two cases?

This can be answered by deriving conditions under which welfare and profit will be higher in the perfectionist equilibrium than in the enthusiastic and lazy equilibrium respectively, and comparing these with the conditions under which the perfectionist equilibrium will arise.

The expected welfare of the game is the probability that either of the two players end up in a monopoly position times the welfare in this case,

$$W_M = \int_{\theta_M}^{1} Vs\theta d\theta = \frac{3}{8}Vs \tag{76}$$

plus the probability that they compete a la Cournot times the welfare in this case

$$W_C = \int_{\theta_C}^{1} Vs\theta d\theta = \frac{4}{9}Vs. \tag{77}$$

Total welfare for the three equilibria is thus as follows:

$$W(PP) = \left[\gamma^2\frac{4}{9} + 2\gamma(1-\gamma)\frac{3}{8}\right]Vs_P - 2k\left[\gamma s_P^2 + (1-\beta)^2\right]$$

$$= \gamma\frac{V^2}{4k}\left(1-\frac{1}{3}\gamma\right)\left(\frac{9-5\gamma}{36}\right)-2k(1-\beta)^2 \tag{78}$$

$$W(LL) = \left[\gamma^2\frac{4}{9}+2\gamma(1-\gamma)\frac{3}{8}\right]Vs_L - 2ks_L^2 = \gamma^2\frac{V^2}{4k}\left(1-\frac{1}{3}\gamma\right)\left(\frac{9-5\gamma}{36}\right)$$

$$\begin{aligned} W(EE) &= \left[\gamma^2\frac{4}{9}+2\gamma(1-\gamma)\frac{3}{8}+(1-\gamma)^2\left(\beta^2\frac{4}{9}+2(1-\beta)\beta\frac{3}{8}\right)\right]Vs_E - 2k\left[(1-\beta)^2+s_E^2\right] \\ &= \frac{V^2}{72k}\left[\gamma(32-11\gamma)+(1-\gamma)\beta\left[(1-\gamma)(27-11\beta)+5\right]-9\right]\left(\frac{9-5(\gamma+(1-\gamma)\beta)}{36}\right) \\ &\quad -2k(1-\beta)^2 \end{aligned} \tag{79}$$

Consider a situation where α is small such that the individuals will play either a perfectionist or an enthusiastic equilibrium depending on β. Will the equilibrium be characterised by too much or too little perfection from an individual point of view?

The payoff to the individuals is higher in the perfectionist than the enthusiastic equilibrium $\Pi(PP) > \Pi(EE)$ if

$$\gamma(9-5\gamma)^2 > [\gamma+(1-\gamma)\beta][9-5\gamma-5(1-\gamma)\beta]^2 \tag{80}$$

collecting terms and rearranging

$$5(1-\gamma)\beta[18-5(3\gamma+(1-\gamma)\beta)] > (9-5\gamma)[9-15\gamma]. \tag{81}$$

The left hand side is non-negative for all parameter values, whereas the right hand side is negative for $\gamma > 9/15$. This implies that whilst $\gamma > 9/15$ is a sufficient condition for the perfectionist equilibrium to be superior to the enthusiastic, $\gamma < 9/15$ is a necessary condition for the enthusiastic equilibrium to generate a higher payoff.

This implies that if $\beta = 1/2$, that is when the individual is indifferent between the two strategies in both equilibria, a sufficient condition for the perfectionist equilibrium giving a higher payoff is that $\alpha + (1-\alpha)\frac{1}{2} > \frac{9}{15}$ that is $\alpha > \frac{1}{5}$.

If tasks are relatively easy $\beta > 1/2$ individuals will play the enthusiastic equilibrium, even though they would be better of if they could collude and play the perfectionist strategy. The problem is that individuals will have an incentive to deviate and play the enthusiastic strategy instead when the chances are sufficiently high they would succeed. Playing the enthusiastic strategy is however a negative externality since it lowers the professional standards further when they are already low.

If tasks are sufficiently difficult, for example if $\beta = 1/3$ and $\alpha = 1/4$ which gives $\gamma = 1/2$, there will be a perfectionist equilibrium with very high standards. In this case the enthusiastic equilibrium would give a higher payoff, but there will be no individual incentive to deviate. In this case the enthusiastic strategy is a positive externality since it lowers the professional standards when they are very high.

It should be noted that for $\beta = 1/3$ perfectionist gives a higher payoff if $\alpha + (1 - \alpha)/3 > \frac{9}{5}$, that is $\alpha > 2/5$. Hence, it is when tasks are difficult and genius is rare that the enthusiastic equilibrium would be better for the individuals. When tasks are hard but not too hard, and genius is rare but not too rare, the perfectionist equilibrium will not only exist, but it will also be optimal from the point of view of the individuals concerned.

Now the question is, what about welfare, that is the sum of the profit and the consumers' surplus. When does the perfectionist equilibrium generate a higher welfare than the enthusiastic?

There are two ways in which welfare considerations will differ from the individual's. First welfare will be higher in the duopoly, whereas the individuals profit is higher when in a monopoly. Second, it does not matter from a welfare point of view who produces the good as long as it is being produced.

In what follows I show that whilst deviating from a perfectionist equilibrium by being an enthusiast is desirable from a welfare point of view, total welfare is strictly lower in the enthusiastic equilibrium than the perfectionist equilibrium.

The difference between the enthusiastic versus the perfectionist strategy is whether or not to attempt to produce the good if the individual failed to improve his skills. The private incentives whether or not to deviate in the second period are determined by the expected payoff from giving it a go if he failed to increase the reliability of his skills, which is the probability that he will be successful in producing the good times a weighted average of the payoff from being in a monopoly and duopoly respectively,

$$\beta\left(\gamma\frac{1}{9}+(1-\gamma)\frac{13}{8}\right)s_P-ks_P^2. \tag{82}$$

The welfare consequences from such a move are the increment in welfare from increased competition, that is a monopoly being replaced by a duopoly, and the increase in the chance the good is going to be produced at all,

$$\beta\left(\gamma\left[\frac{4}{9}-\frac{3}{8}\right]+(1-\gamma)\frac{3}{8}\right)s_P-ks_P^2. \tag{83}$$

The private returns are higher when there is Cournot competition replacing a monopoly, since the Cournot profit is higher than the increase in welfare from moving from monopoly to duopoly, that is $1/9 > 5/72$, whereas the private returns are lower when the result of going ahead implies the good is produced when it otherwise would not have been. Whether the private incentives are stronger or weaker than the social ones will therefore depend on which of these outcomes is the more likely.

The social incentives are stronger if

$$\left(\gamma\frac{5}{72}+(1-\gamma)\frac{3}{8}\right)>\left(\gamma\frac{1}{9}+(1-\gamma)\frac{13}{8}\right) \tag{84}$$

which simplifies to $\gamma < \frac{3}{4}$. Solving for α this condition becomes

$$\alpha<\left[\frac{3}{4}-\beta\right]\frac{1}{1-\beta}. \tag{85}$$

This condition is satisfied when we have a perfectionist equilibrium, since $\beta < 1/2$ requires $\alpha < 1/2$ which holds in that case. The individual's optimal strategy is to be a perfectionist, that is to abstain from trying to deliver when he failed improving his skills, when from a welfare point of view going ahead would have been optimal. Hence, here we have an example of the best being an enemy of the good. However, this is only true when the professional standards are those of a perfectionist equilibrium.

If individuals are encouraged to give it a go regardless professional standards will fall, since it will no longer be optimal for those who have reliable skills to aim as high. As a result welfare will be lower in the enthusiastic equilibrium.

The welfare is higher in the perfectionist equilibrium than the enthusiastic equilibrium if

$$\gamma\frac{54-22\gamma}{72}V[s_P-s_E]+2k[s_E^2-\gamma s_P^2]-(1-\gamma)^2\left(\frac{54-22\beta}{72}\right)\beta V s_E>0 \tag{86}$$

The first effect is the higher quality in the perfectionist equilibrium. The second effect is the difference in cost. The third effect is the fact that there will be some production of the good even if the individuals fail in achieving perfection. The first effect is positive. The second effect is positive if $s_E^2-\gamma s_P^2$ which is true if

$$(1-\gamma)[(9-5\gamma)[9-5\alpha(1-\beta)-15\beta]+25\beta^2(1-\gamma)]>0 \tag{87}$$

This condition is satisfied as long as β is not too close to one. Hence, the more reliable production will compensate for the higher cost of quality in the perfectionist equilibrium as long as reliability is not too high a priori. The third effect is however negative, since it is the welfare gain from having the good materialising more frequently thanks to the enthusiasm of those who failed. Hence, it depends on which effect dominates.

Substitution for s_P and s_E in (86) and simplifying the condition becomes,

$$(1-\gamma)[\gamma(27-11\gamma)5\beta+(9-5\gamma)[9-5\gamma-(10+(1-\gamma)(27-11\beta))\beta]+5(1-\gamma)\beta^2[5+(1-\gamma)(27-11\beta)]]>0. \tag{88}$$

This condition holds for all β. Hence, the positive effect on quality from perfectionism and cost saving from only producing when it can be done reliably, always dominate the negative effect on quantity produced.

Next consider the case where tasks are difficult, that is when $\beta<1/2$. Depending on α there will then be a perfectionist or a lazy equilibrium. Are incentives distorted in this case?

The profit is higher in the perfectionist than the lazy equilibrium $\Pi(PP)>\Pi(LL)$ if

$$s_P^2>\frac{(1-\beta)^2}{(1-\gamma)\gamma}=\frac{(1-\beta)}{(1-\alpha)\gamma}. \tag{89}$$

Two interesting observations can be made. First compare (89) with the condition not to deviate by being lazy (35) in a perfectionist equilibrium

$$\frac{1-\beta}{1-\alpha} < s_P^2 < \frac{1-\beta}{(1-\alpha)\gamma}, \tag{90}$$

there is a perfectionist equilibrium, even though individuals would be better off being lazy. Second compare it with the condition not to deviate by being a perfectionist (59) in a lazy equilibrium. Since $s_L^2 = \gamma^2 s_P$, one can write

$$\frac{1-\beta}{(1-\alpha)\gamma} < s_P^2 < \frac{1-\beta}{(1-\alpha)\gamma^2}. \tag{91}$$

Here the lazy strategy is a Nash equilibrium, even though individuals would be better off being perfectinoists.

Since s_P has to be higher in the latter case, this shows that if individuals play the lazy equilibrium when standards in the perfectionist would be very high, they would be better off begin perfectionists, whereas if standards are not so high and they play the perfectionist strategy they would be better off being lazy.

Next consider welfare. The first derivative with respect to genius α is

$$\frac{\partial W(PP)}{\partial \alpha} = \frac{V^2}{4k}\frac{(1-\beta)}{36}\left[9 - 16\gamma + 5\gamma^2\right] \tag{92}$$

the sign depends on a second order equation in γ. The negative root is

$$\gamma_1 = \frac{8-\sqrt{19}}{5} \approx \frac{3.6}{5} \tag{93}$$

This one can be compared with (25)which is increasing until $\gamma = 9/15 < 3.6/5$. Total welfare reaches a maximum for a higher γ than the private payoff. There are two effects on welfare. One is the positive effect that it is more likely the good is going to be delivered, which is positive. The second is that it is going to be of lower quality, which is negative.

The perfectionist equilibrium generates a higher welfare than the lazy equilibrium if

$$\left[\gamma^2\frac{4}{9} + 2\gamma(1-\gamma)\frac{3}{8}\right] V[s_P - s_L] > 2k\left[\gamma s_P^2 + (1-\beta)^2 - s_L^2\right] \tag{94}$$

hence, if the expected welfare gain from higher quality is larger than the expected increment in costs. This can alternatively be written

$$\gamma(1-\gamma)\frac{V^2}{4k}\left(1-\frac{1}{3}\gamma\right)\left(\frac{9-5\gamma}{36}\right) > 2k(1-\beta)^2. \tag{95}$$

The difference in the expected value of what is produced in the perfectionist and lazy equilibrium respectively has to be higher than the sunk cost to the individuals which is incurred when they practice. The sunk cost is times two, since both individuals practice in the perfectionist equilibrium.

This condition allows us to make two observations. First, comparing it with the difference in equilibrium payoff between the perfectionist and the lazy equilibrium

$$\gamma(1-\gamma)\frac{V^2}{4k}\left(\frac{9-5\gamma}{36}\right)^2 > k(1-\beta)^2, \tag{96}$$

gives,

$$\gamma(1-\gamma)\frac{V^2}{4k}\left(\frac{9-5\gamma}{36}\right)\left(1-\frac{1}{3}\gamma-2\left(\frac{9-5\gamma}{36}\right)\right) > 0. \tag{97}$$

The welfare gains from perfection are larger than the private gains in equilibrium. However, the individuals may play a perfectionist equilibrium even though they would be better off coordinating on being lazy. Thus it is possible that private and social incentives may coincide in this case.

Rearranging terms (95) can be written in a form similar to (35),

$$\gamma\left(\frac{3-\gamma}{6}\right)\left(\frac{9-5\gamma}{36}\right)\frac{V^2}{4k^2} > \frac{1-\beta}{1-\alpha}. \tag{98}$$

When $\beta < 1/2$, there is either a perfectionist or a lazy equilibrium. Social and private incentives for perfection coincide if

$$\gamma\left(\frac{3-\gamma}{6}\right)\left(\frac{9-5\gamma}{36}\right)\frac{V^2}{4k^2} = \left(\frac{9-5\gamma}{36}\right)^2\frac{V^2}{4k^2} \tag{99}$$

which can be simplified to

$$\gamma^2 - \frac{23}{6}\gamma + \frac{3}{2} = 0. \tag{100}$$

This equation has two roots. The positive one can be ruled out since it is outside the domain of γ. The negative root is

$$\tilde{\gamma} = \frac{23-\sqrt{313}}{12} \approx \frac{1}{2}. \tag{101}$$

For $\gamma < \tilde{\gamma}$ the social incentive is stronger than the private, and for $\gamma > \tilde{\gamma}$ the social incentive is weaker.

V Conclusion

This paper has revealed that for example musicians may be better off collectively being enthusiasts, choosing an easier repertoire, playing more and making more mistakes, but thanks to there being an incentive to practise when tasks are sufficiently difficult,[11] they play the perfectionist equilibrium giving their audience the pleasure of outstanding performances. This outcome is preferable from a welfare point of view, since it matters less to the audience that there was a number of aspiring musicians who never got there. Had all of them been around trying to play the repertoire, they may individually have been better off, but the increase in competition would have lowered the returns to quality and therefore the equilibrium standards giving the audience more performances of lower quality.

The results in this paper were derived in a highly stylized model, which the author believes to be the simplest representation of the intuition behind the results. In this concluding section the various assumptions will be discussed in turn.

The assumption that the individual faces the same opportunity cost of time when acquiring skills as when working is not crucial for the result. Different costs here would only add complexity to the model without changing the results. Quadratic opportunity cost of time is the reason why we get critical values of one half. It does not affect the qualitative results.

Since ex ante reliability depends on the difficulty of the task, it will determine both the effort required to achieve perfection as well as whether the effort will be worthwhile. Hence, these two factors should be related and the way it is modelled

[11] Since practising does not only increase the chances of being able to deliver whichever standards are expected, but also informative about ability or lack thereof, an individual who practised but failed will be more reluctant to try meeting the standards than he was prior to practising.

is the simplest way that this can be achieved. The assumption that the probability of being able to achieve perfection in skills is the same as the probability being able to deliver professionally without practice is not limiting either. We can get the same qualitative results when these probabilities differ.

Having only two players is also for analytical convenience. The intuition that there will be less competition if it is harder to achieve perfection would still be valid with more players, since when we have Cournot competition there will be a non-linear reduction in profits as the number of competitors increase. Hence, the two player case is the simplest possible scenario which captures the effect of different levels of competition. The assumption on the demand side of linearity again only affect parameter values and have no qualitative impact.

The assumption is made that you either meet the standards or you do not, for example you are either able to play a piece or you are not. This is definitely true for professional musicians. Giving a concert when you cannot quite manage the piece is death. Or in research where you have either managed to prove something or you have not. In the case of practising it captures situations where failing despite practising is an indication that the way the individual practices is not effective and therefore a pure waste of time. There are professions in which you do not have to match the highest standards, but can sell a product of inferior quality. In this case there would be a possibility of the two agents ending up in a vertically differentiated duopoly. This makes the model more complicated and the author has found that it would not change the qualitative results, since the payoff would still be higher for the individual delivering the high quality product, and therefore an incentive to practice when returns to practising are high.

The assumption which deserve a more detailed comment is the discrete nature of reliability of skills. The author has also solved the problem where the reliability is a continuous choice variable, and derived conditions under which there will be a corner solution. that is if the individual practices she will aim for perfection. Again we get in this case a more complex model with the same qualitative results. Hence, it is the simplest model which captures the qualitative results of more realistic and complex models of the same problem. Adding a bit of complexity will generate some additional insights by allowing comparative statics for a larger set of parameter values.

Finally, the model does reflect received wisdom by having an element of *beginner's luck*, since you can get it right without practice, but you may fail completely if you try again. Hence, the model describes a situation where practice is about making ones skills more reliable rather than being able to do it at all. This is a crucial ingredient of the model, since it explains why you can get away with it without practising, or having practised but failed to make the skills reliable. Furthermore whilst 'the best is the enemy of the good' in the sense that it is better from a welfare point of view to be an enthusiast than a perfectionist in the perfectionist equilibrium, the welfare in an enthusiastic equilibrium would be strictly lower. This is because professional standards would fall if everybody adopted an enthusiastic strategy which would dominate the positive effect from more goods being produced. The rather provocative conclusion from this result is that if individuals have invested time in trying to make their skills more reliable, only those who succeeded should go ahead producing the good.

If the chances are good an individual could do it without practice, the individual may adopt a lazy strategy, resulting in a lazy equilibrium with lazy standards, even though welfare would have been higher had he been a perfectionist. This result encapsulates a quote by Franz Liszt '*genie oblige*'.

Practising is an investment in human capital that may be underprovided for, since the welfare gains from practice and perfection are higher than the private returns. This complements the finding that there is too little human capital is devoted to research in equilibrium in an endogenous growth model (Romer 1990). Hence, it is an additional argument in favour of government funding of eduation.

This paper has modelled one important sunk cost in creative industries, namely the cost of making ones skills more reliable. Given that there is too little perfectionism, a question left for future research is how can perfection be encouraged?

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