Signalling, Wage Structure, and Unions
Supervision 1

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Question 1

In the basic form, the signalling model has some strong assumptions. There are two types of workers, one with low ability and productivity p_L, and another with high ability and productivity p_H, with $p_H > p_L$. Education has no effect on productivity, but the cost of education is higher for the low-ability worker (which drives the main result of the model). This does not necessarily mean the low-ability worker pays more for the sticker price of education, but it can capture the fact that high-ability workers require less effort to pass a certain education program and are less likely to drop out without any qualifications. In fact, if education is modelled as a probabilistic process with the same cost price across ability types, but low-ability individuals have a higher chance of dropping out while wasting one period not working, this can be simply re-expressed as a higher expected cost for the low-ability individual.

(a)

In the first-best case, firms would pay workers their marginal products, meaning high-ability individuals receive a higher wage equal to p_H while low-ability individuals receive a lower wage equal to p_L. In this case there is an asymmetry of information, where workers know their own type but firms do not know the type of the individual being hired.

If the costs of education differ between types of workers, and the firms know this, they can design an incentive-compatible menu of contracts that minimizes the loss to the firm relative to the first-best case. By making education a pre-requisite for a higher wage offer, the different costs of education make it such that high-ability workers find it worthwhile to pay for education in order to receive a higher wage while low-ability workers find it worthwhile to just receive the lower wage since education is too expensive for them. Firms pay higher wages for better educated workers because only workers with higher productivity will receive education if the firms offer an appropriate menu of contracts.

(b)

Educational institutions should be able to distinguish between low-ability and high-ability individuals for this model to be tractable. They do not have to do so perfectly; all that is needed is for the educational institutions to make it sufficiently costly for a low-ability individual to present themselves as high-ability individuals. For example, universities may not perfectly distinguish between high-ability and low-ability individuals because their methods of assessment (tests, coursework, supervisions) are not perfect and also susceptible to cheating. However, this in itself is enough to create a cost differential between high-ability and low-ability individuals pursuing education, allowing firms to exploit this in their wage offers so as to design an incentive-compatible menu of

contracts. In the model we assume that firms have totally no ability to discern their job applicants' ability types, so educational institutions have an advantage in this area. These institutions have such an "advantage" out of necessity; without it, the value of the degree would be eroded to nothing. Thus they are incentivized to develop these informational capabilities that allow them to discern (even if imperfectly) the quality of their students.

(c)

It is very rare for taxes on education to be considered, because education is generally perceived as an under-provided good. There are several reasons for this: one might be that the private returns to education are lower than the social returns to education (more on this in Question 2). Another important reason is that many people who would have the highest marginal benefit from education are liquidity-constrained. If this is due to imperfections in the capital market (it does not necessarily have to be), then a disequilibrium in the capital market carries over to a disequilibrium in the market for education. Walras's Law is at play here: an excess demand for loanable funds is the counterpart to a shortfall in demand for education at the prevailing prices. For example, in rural communities, access to capital markets tends to be poor and financial systems are often underdeveloped. This means that many children (especially girls) are locked into engaging in household production or agricultural/proto-industrial activity; they cannot borrow against their future income in order to stay afloat when forgoing earnings for several years while studying.

This is actually relevant to something called a "graduate tax" that has been considered before. The proposal was for education to be heavily subsidized or free, while tuition fees would be solely funded by a long-term tax on future income after the student graduates. While not really a traditional tax on education per se (in that it doesn't necessarily lower the private return to education), this would benefit the liquidity-constrained individuals discussed above.

As for a traditional tax on education, it is really not clear who would benefit from this until we consider what the taxes are spent on. And the ones who lose out are those with difficult access to education in the first place.

(d)

Again, it is not clear why a prohibition of education would be something that is desired. The empirical evidence seems to show quite convincingly that any concerns about negative externalities from "signaling" probably pale in comparison to the under-provision of education in many countries. Putting that aside, it is unlikely that a prohibition on any form of education will be easily enforceable. Human capital development has not always been provided by official institutions. On-the-job training and apprenticeships were provided by firms, guilds, and individual craftsmen in Victorian Britain. One exception might be if education is prohibited due to cultural reasons; this might be the case for female education in countries such as Bangladesh or Pakistan. There is really not much to say about this since the motivations for such a policy are dubious and a purely economic analysis is anyway of limited use.

Question 2

(a)

In a close-to-first-best world, where the social returns to education are close to the private returns, there are reasons to think that leaving the provision of education to the market produces better

outcomes. One proposed explanation is that market incentives and competition lead to better quality of education. Hoxby's (2000) influential and controversial paper used geographical features (number of streams) to instrument for the amount of school districts that a household can choose from. Her results suggested that competition among public schools benefited students by raising achievement and lowering spending.

(b)

As mentioned before, subsidizing education might be useful if the social returns exceed the private returns. A full treatment of the theory will be more or less what was covered in the lectures, and this is anyway pretty much what Question 3 will be asking, so the focus is instead on the empirical evidence.

At the macro level, while the simple correlation between human capital and GDP per capita is strong, there is surprisingly very mixed data on the effects of human capital accumulation on economic growth. It is well understood that there is a possibility of two-way causation and underlying influences behind this correlation. Looking deeper, the historical growth path of output and the growth path of education does not provide compelling evidence that education causes growth. The broad problems with the macro data are as such.

The OECD countries over 1880-1994 show no indication of generalized acceleration of economic growth, yet virtually every measure of education has hugely expanded. This ranges from primary schooling to number of research scientists, both the absolute levels and as a percentage of the labour force. Since the 1960s, the huge expansion in education in nearly every country in the world meant a convergence across countries in education per worker: the unweighted standard deviation of log years of schooling of people over age 15 fell by by 40% between 1960 and 1995. Yet with this convergence in education, what we are observing is a divergence in output per worker: the unweighted standard deviation of log real GDP per capita has increased by 22% over the same period. There has been a nearly universal slowdown in economic growth rates from 1960-2000 even with an *acceleration* (not just increasing levels but increasing *rates*) in education growth. In non-OECD countries, growth of output per worker was 2.6% per annum in the 1960s, 2.2% p.a. in the 1970s, 0.7% p.a. in the 1980s, and 1.4% p.a. in the 1990s.

Also, when we look at less developed countries (LDCs), their growth path in the medium and long horizon exhibits enormous instability. In the OECD, the stable trend explains 95% of variance in log output per worker over a 30 year horizon. In 40% of LDCs it explains less than half of the variance. By contrast, the education of the labour force in those countries evolve smoothly with little time-series volatility, and schooling per worker 'explains' just under 7% of variance in growth performence in LDCs over the 30-year horizon. The link between education and growth seems to be tenuous at best.

The last bit of relevant macro data is that the total factor productivity (TFP) in LDCs after adjusting for physical and human capital seems to either be very small or even negative in more than half of all LDCs. This isn't surprising since it was mentioned that growth in output was slow while growth in education has been accelerating. This is peculiar since LDCs are far from the world technological frontier, and it is usually an empirical fact that TFP for such countries have higher "residual" growth. This suggests that LDCs are getting less output from given inputs.

One explanation for these peculiarities could be that the quality of education plays a large part. For example, student-teacher ratios in 2005 were on average 16 for more developed countries (MDCs), 42 for LDCs, and 48 for sub-Saharan Africa. In Mozambique 70% of teachers of years 1-5 have just 7 years of schooling themselves. And in many LDCs students have to share textbooks. Yet almost all cross-country analyses use "years of schooling" as their measure of education, which

probably understates the true difference in human capital per worker across countries.

The micro data does suggest that education has positive externalities (although this just raises again the question of why this isn't reflected in macro trends). Weir & Knight (2007) estimate that in rural Ethiopia, more than half of the benefit of an individual going to school for one more year accrued to other individuals. The channel is said to be through innovation: educated farmers adopt new techniques first, which are then copied by less-educated neighbours.

Overall there are compelling theoretical reasons why one might want to subsidize education (positive externalities, liquidity constraints), but in practice it turns out that the link between education and material well-being isn't very decisive.

References

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Question 3

(a)

Society's production net of costs is

$$\begin{aligned} Y - C &= A(QK)^{\alpha} E^{1-\alpha} - E^2 \\ &= A\left(\frac{EK}{N}\right)^{\alpha} E^{1-\alpha} - E^2 \\ &= A\left(\frac{K}{N}\right)^{\alpha} E - E^2 \end{aligned}$$

and the first-order condition for the optimal level of E is

$$\begin{aligned} A\left(\frac{K}{N}\right)^{\alpha} - 2E &= 0 \\ E &= \frac{A}{2}\left(\frac{K}{N}\right)^{\alpha} \end{aligned}$$

(b)

The individual seeks to maximize

$$y - c = A(Qk)^{\alpha} e^{1-\alpha} - e^2$$

Assuming the individual's choice of e does not significantly change the average educational level $Q = \frac{E}{N} = \bar{E}$, the first-order condition for a maximum is

$$(1-\alpha)A(Qk)^{\alpha}e^{-\alpha} - 2e = 0$$

Substituting $Q = \frac{E}{N} = e$ back inside,

$$\begin{aligned}(1-\alpha)Ak^{\alpha} - 2e &= 0\\ e &= \frac{A(1-\alpha)}{2}k^{\alpha}\end{aligned}$$

(c)

From (a) and (b), $e^* = (1-\alpha)E^*$. Whether E or $N \cdot e$ is bigger depends on whether $N(1-\alpha) > 1$.[1]

(d)

Since $E^* > N \cdot e^*$, this means that a subsidy on individual income is needed for the individually optimal amount of education to aggregate into the social optimal level. We introduce a subsidy which pays a proportion s of y, $0 < s \leq 1$. The individual now seeks to maximize

$$(1+s)y - c = (1+s)A(Qk)^{\alpha}e^{1-\alpha} - e^2$$

and the first-order condition for a maximum is

$$(1-\alpha)(1+s)A(Qk)^{\alpha}e^{-\alpha} - 2e = 0$$

Again, substituting $Q = e$,

$$\begin{aligned}(1-\alpha)(1+s)Ak^{\alpha} - 2e &= 0\\ e &= \frac{(1-\alpha)(1+s)A}{2}k^{\alpha}\end{aligned}$$

We want individuals to choose $e^* \equiv \frac{E^*}{N} = \frac{A}{2}k^{\alpha}$, so we should set s such that $(1-\alpha)(1+s) = 1$. This means

$$\begin{aligned}1 + s - \alpha - \alpha s &= 1\\ s(1-\alpha) &= \alpha\\ s &= \frac{\alpha}{1-\alpha}\end{aligned}$$

[1] This result feels wrong; my guess is that C should actually be $Nc = Ne^2 = \frac{E^2}{N}$ instead of E^2. In this case the optimal level of E becomes $\frac{AN}{2}\left(\frac{K}{N}\right)^{\alpha}$, and $e^* = \frac{1-\alpha}{N}E^*$. This means that E is bigger than $N \cdot e$. I will answer part (d) based on this assumption, but I leave the working above in case I'm wrong.