Contracts & Regulations, Education & Health
Supervision 6

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Question 1

(a)

To get the separating equilibria, we guess at a set of beliefs held by the firm and check that they are confirmed in the resulting equilibrium. Specifically, we guess that there exists some e^* such that the firm believes workers have productivity $\theta_L = 1$ if their education level is $e_L < e^*$, and that workers have productivity $\theta_H = 2$ if their education level is $e_H \geq e^*$. We assume perfect competition where firms offer workers their marginal product. So given these beliefs, the firm announces the following wage schedule $w(e)$:

$$w(e) = \begin{cases} 1 & \text{if } e < e^* \\ 2 & \text{if } e \geq e^* \end{cases}$$

Workers take the above as given, and choose their levels of education accordingly. We can see that for the firm's beliefs to be true, the low-productivity workers must choose $e_L = 0$ while the high-productivity workers must choose $e_H = e^*$; both types have no incentive to marginally increase their level of education given that the wage schedule is a step function. Lastly, we have to make sure that the incentive compatibility constraints are satisfied, that is

$$\begin{aligned} u(w(e_L), e_L, \theta_L) &\geq u(w(e_H), e_H, \theta_L) \\ u(w(e_H), e_H, \theta_H) &\geq u(w(e_L), e_L, \theta_H) \end{aligned}$$

The above translates to the following

$$\left.\begin{aligned} 1 \geq 2 - e^* \quad &\implies \quad e^* \geq 1 \\ 2 - \tfrac{e^*}{2} \geq 1 \quad &\implies \quad e^* \leq 2 \end{aligned}\right\} \implies 1 \leq e^* \leq 2$$

This means that the beliefs described above can support a separating equilibrium if $1 \leq e^* \leq 2$. The same goes for similar beliefs, like if the firm believes workers have high productivity if $e_H = e^*$ and low productivity if $e_H \neq e_L$. But it should be said that there is no reason for these to be the only separating equilibria. We haven't considered possible equilibria with stochastic beliefs or actions; for example where the firm attaches probabilities to worker productivity given the education level, or where workers probabilistically choose between different levels of education. And there might be profitable ways for workers to form coalitions and attain a different equilibrium.

For the pooling equilibria, suppose the proportion λ_L of workers with low productivity is common knowledge and that firms are risk-neutral. In any pooling equilibrium the firm's expected profit is

$$\mathbb{E}[\pi|w] = \lambda_L + (1-\lambda_L)\times 2 - w$$

Again, perfect competition implies the following condition:

$$\mathbb{E}[\pi|w] = \lambda_L + (1-\lambda_L)\times 2 - w = 0 \implies w = 2 - \lambda_L$$

Suppose further that the firm believes the productivity of workers with education level $e \geq e^*$ follows the same distribution as in the population, whereas anyone with education level $e_L < e^*$ has low productivity (this potentially violates Bayes's rule, but if $e_L < e^*$ is never realised then the concept of a perfect Bayesian equilibrium makes no restrictions on beliefs regarding that game path). Then, the wage schedule is

$$w(e) = \begin{cases} 1 & \text{if } e < e^* \\ 2-\lambda_L & \text{if } e \geq e^* \end{cases}$$

Then, if a pooling equilibrium exists, it must be that all workers choose $e = e^*$ for the same reason as before. Furthermore, no one must find it profitable to switch to $e_L < e^*$. Again, we only have to consider $e_L = 0$, so the following conditions must hold:

$$\left.\begin{array}{l} 2-\lambda_L - e^* \geq 1 \implies e^* \leq 1-\lambda_L \\ 2-\lambda_L - \frac{e^*}{2} \geq 1 \implies e^* \leq 2(1-\lambda_L) \end{array}\right\} \implies e^* \leq 1-\lambda_L$$

So we have the set of e^* for which beliefs of this sort sustain a pooling equilibrium, and the same caveats from before apply.

(b)

In the Rothschild–Stiglitz screening model, the population distribution and model parameters are completely pre-determined and are common knowledge; the rewards of deviating from a pooling equilibrium are objectively known and there is no room for prior beliefs to sustain a pooling equilibrium. In the Spence model, the presence of education provides a degree of freedom allowing certain pooling equilibria to persist.

It is easy to see how dependent the pooling equilibria in the Spence model are on prior beliefs. Consider the pooling equilibrium discussed before; suppose that the firm's beliefs are instead that workers with education level $e = e^*$ follows the same distribution as in the population, whereas anyone with education level $e_H > e^*$ has high productivity while anyone with education level $e_L < e^*$ has low productivity (now this can actually satisfy Bayes's rule even if all 3 possibilities are realised with positive probability). If everyone chooses $e = e^*$, the belief turns out to be true, but the firm has an incentive to offer a wage marginally higher than the average population productivity, say, $w = 2 - \lambda_L + \delta_w$, to workers with education level marginally higher than e^*, say, $e_H = e^* + \delta_e$, with $\delta_w < \delta_e < 2\delta_w$. Then the workers with higher productivity will take up this new contract, while the firm will earn positive profits $\lambda_L - \delta_w$, breaking the pooling equilibrium. So having a pooling equilibrium depends on having the 'right' beliefs.

(c)

In both problems, the 'bad' types are the lowest of the low, and there is no room to punish them for their deceit in a separating equilibrium. The only thing we can do is to make the 'good' types slightly worse off by cutting into their social surplus so that mimicking them no longer becomes as attractive.

Question 2

(a)

We convert the insurer's costs into real resource costs by assuming the insurer pays for the drug in bad states of the world, which means the insured have known and constant utility across all states. Without insurance, the Belgians will always buy the drug in bad states of the world, so if insurance coverage costs €C, we must have

$$\sqrt{2500 - C} \geq \frac{1}{2}\sqrt{2500} + \frac{1}{2}\sqrt{2500 - 900} = 45$$

which implies $C \leq 475$, and the upper bound is also equal to the risk premium.

(b)

Given that $C \leq 475$, all the Belgians will purchase insurance and there is no adverse selection problem, which means the ex-ante expectation is that half of the insured will incur the €900 cost. The ex-ante expected profit of the insurer given $C \leq 475$ is

$$\mathbb{E}[\pi] = N\left(€C - \frac{1}{2} \times €900 - €5\right)$$

where N is the number of insured Belgians, and the expected profit is positive if $455 < C \leq 475$.

(c)

We expect Bertrand competition to take place which means expected profits get driven to zero in equilibrium; prices are driven down to €455. The expected utility of Belgians is

$$\mathbb{E}[U] = \sqrt{2500 - 455} \approx 45.22$$

(d)

If Belgians are made to take the test before purchasing insurance, those testing negative will never buy the insurance since the posterior probability of having the disease is zero. Conditional on positive test results, the Belgians will only go through with the insurance coverage if

$$\sqrt{2500 - C} \geq \frac{1}{4}\sqrt{2500} + \frac{3}{4}\sqrt{2500 - 900} \implies C \leq 693.75$$

Assuming Bertrand competition implies expected profits are zero. This means

$$\mathbb{E}[\pi] = \mathbb{E}[N^{+}] \left(€C - \frac{3}{4} \times €900 - €5 \right) = 0 \implies C = 680$$

where N^{+} is the number of Belgians testing positive. The expected profit of firms are zero before and after instituting the testing policy, so we can disregard profits in assessing welfare. The ex-ante expected utility of Belgians is therefore

$$\frac{1}{3}\sqrt{2500} + \frac{2}{3}\sqrt{2500 - 680} \approx 45.1$$

which is less than before the testing was implemented. This means the use of the test is strictly welfare reducing and should not be approved. The reason this happens is that the test screens out healthy Belgians, removing the possibility of sharing risks with those who are healthy and can bear additional risk for lower costs.

Question 3

(a)

The trade-offs would depend on the type of private insurance system that arises. One thing that a public system can do, which a competitive and unregulated private system cannot, is that a public system can enforce the Rothschild–Stiglitz pooling equilibrium by committing to a single price for coverage. In a private system there is scope for individual insurers to profit by deviating from the pooling equilibrium and offer coverage on terms that are preferred by low-risk individuals but not high-risk individuals. Therefore we get the standard second-best result where low-risk individuals are offered less than complete insurance so that high-risk individuals stick to the contract meant for them. So there is an efficiency cost in moving to the private system since some risk is borne by the risk-averse low-risk individuals instead of the risk-neutral insurers.

One feature of the Medicare system is that Canadians do not face the marginal costs of healthcare since medical services are free of charge at the point of use. Therefore individuals will make use of medical services until the marginal benefit of doing so is driven down to zero, rather than when the marginal benefit is equated with the marginal cost of provision. This is a source of allocative inefficiency since resources are being diverted to a process where costs exceed benefits. If the new private system can accommodate some form of co-payments, individuals will be exposed to some the marginal costs of healthcare and some efficiency can be restored. However, there is likely an equity trade-off since those with lower ability to pay cannot consume as much. Furthermore, there may be additional equity trade-offs if healthcare provision under the old system was de-facto rationed through queues and wait times. Those with higher wages have a higher opportunity cost of queueing and waiting, so the old system would have been more beneficial to lower-wage individuals.

Despite referring to the effects above as equity trade-offs, there might even be some efficiency losses if there are people whose ability to pay are so constrained that they only can make use of medical services to a point where marginal costs are still lower than marginal benefits, like when the poor cannot afford relatively cheap but high-benefit medical interventions (say, in terms of quality-adjusted life years) like hip replacements.

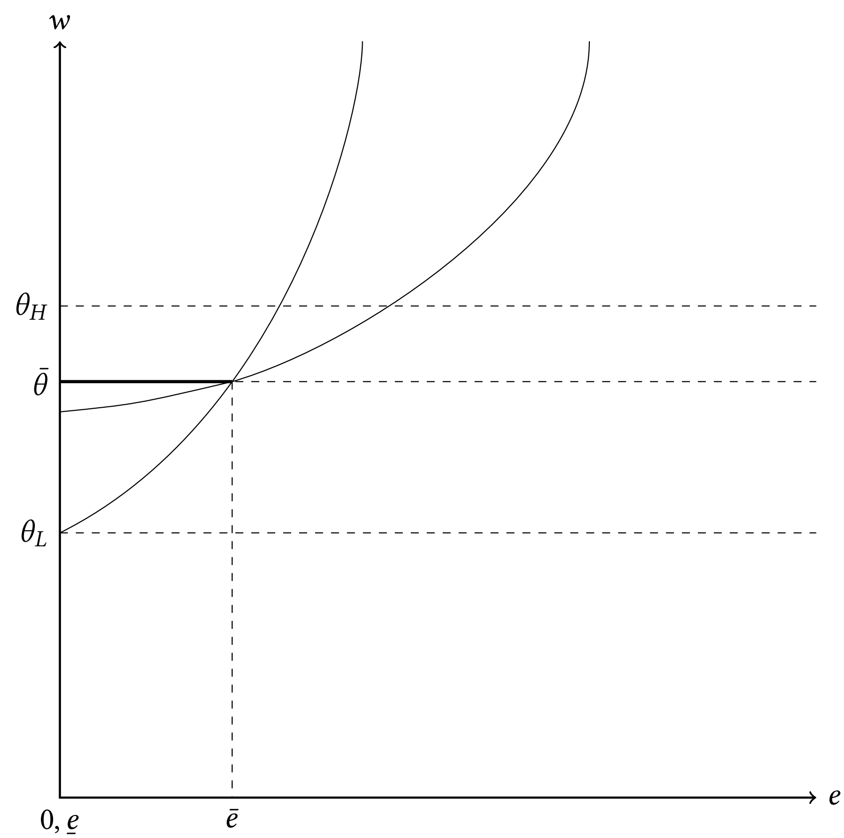
(b)

Continuing the discussion of separating equilibria from before, if the proportion of low-risk types is sufficiently high, then the population average risk might be low enough for a pooling contract to yield positive profits. This means any feasible separating equilibrium can be broken by a firm deviating to offer a pooling contract, but this pooling equilibrium must break down due to the same reason as before. Therefore, there may be no equilibrium in the long-run and the insurance market may break down if there are too few high-risk types in the country.

Question 4

(a)

Using the same notation from 1(a), but letting $\bar{\theta} = \lambda_L \theta_L + (1 - \lambda_L)\theta_H$, we have



The exposition for this is identical to 1(a).

(b)

If $e^* > 0$ then the pooling equilibrium is not even second-best: there is a feasible Pareto gain from moving to the equilibrium where $e^* = 0$, in which case the allocation is second-best. The pooling equilibrium is also first-best if it is preferred to the best separating equilibrium. This will depend on $\bar{\theta}$.

(c)

As in 1(a).

(d)

Again, this depends on $\bar{\theta}$. Skipping the steps we already went through in 1(a), the levels of e_H which can support a separating equilibrium satisfy

$$\Delta\theta \leq e_H \leq 2\Delta\theta$$

where $\Delta\theta = \theta_H - \theta_L$, and assuming the same cost of education as in 1(a). The best separating equilibrium is where e_H is at the lower bound $\Delta\theta$. Then, the best separating equilibrium utilities are

$$\begin{aligned} U_L^{\text{Separating}} &= w_L - e_L = \theta_L \\ U_H^{\text{Separating}} &= w_H - \frac{e_H}{2} = \frac{\theta_H + \theta_L}{2} \end{aligned}$$

Similarly, the best pooling equilibrium is where $e^* = 0$. The best pooling equilibrium utilities are

$$\begin{aligned} U_L^{\text{Pooling}} &= w - e^* = \bar{\theta} \\ U_H^{\text{Pooling}} &= w - \frac{e^*}{2} = \bar{\theta} \end{aligned}$$

The best pooling equilibrium is always better than the best separating equilibriumm for the low-productivity individuals, but it is only better for the high-productivity individuals if the average productivity in the population is higher than the arithmetic mean of the two productivity levels. That is, the pooling equilibrium is more efficient according to the Pareto criterion only if $\lambda_L \leq \frac{1}{2}$. If $\lambda_L > \frac{1}{2}$, then there is no Pareto improvement from moving between the two best equilibria, and we would need to impose a social welfare function to evaluate efficiency.