This document provides a sketch of solutions to the exam. The provided solutions are intended as a guide to answering the questions, and are not meant as exhaustive. The written solutions would have to be worked out more completely.

Financing of Higher Education

This exam explores the financing of higher education, or universities. Take as a point of departure the case of Denmark. In the fall of 2015, the liberal government in Denmark has decided to restrict public spending, which will also affect spending on education.

1. Universities will have to reduce their budgets by 2% annually for the next 4 years. At the moment, it is not yet clear how the savings will be achieved. But one possible way will be to ask professors to teach more. One could interpret this increase in the teaching load for professors as lowering the quality of universities (larger classrooms, professor spend less time preparing lectures, fewer hours for direct supervision, less personal feedback, etc.). Indeed, this is how the chairman of the Danish students union Yasmin Davali sees it, "the cuts will almost certainly lead to lower quality in an already pressured education system."[1]

   (a) What impact would this reduction in teaching resources have on the individual demand for human capital in general? Explain how the aggregate acquisition of human capital would be affected - argue both in terms of a model of human capital as well as in terms of intuition in plain language.

   Solution:
   For this question, the Ben-Porath model is useful. It studies private demand for education as a function of expected returns to education, student ability and expenditures or *resources in education* (not only books, also teachers etc.). Keep in mind this model assumes perfect credit markets.

   In this model, the private optimal demand for education is an *increasing* function of expenditures. Thus, if they fall, optimal individual demand falls, and therefore also aggregate educational attainment.

   The intuition is that a given *time investment* in education is no longer as productive as it used to be (fewer resources are joined). The students trade off the opportunity cost of studying, which is the wage they would earn otherwise, with the expected productivity (and thus wage) gain. If the productivity/wage gain is reduced, the equality between marginal cost and benefit of investing is reached sooner (after fewer years studying, say). Thus, individuals obtain less schooling (note this is not a zero/one decision, but about how much to invest).

   The assumptions of this model, in particular the perfect credit market assumption, would tend to only favor educational attainment, so the conclusion

[1] Cited in this article http://universitypost.dk/article/danish-government-billions-be-cut-university-budgets of August 31, 2015.

that educational attainment would fall is not dependent on this particularly worrisome assumption.

(b) Which type of student would be affected more by the change in teaching resources, high ability students or low ability students? Is inequality worsened by reduced expenditures on schooling?
(Follow the assumptions of the basic human capital models we have seen, which model educational expenditures (teaching resources) and individual ability to be imperfect substitutes and to enter multiplicatively in the human capital production function.)

Solution:

In terms of the previous model, here you should think of the second derivative of optimal schooling with respect to expenditures and ability (we have also referred to it as cross-derivative). This cross-derivative is positive, implying that optimal schooling increases more strongly with a resource increase for high-ability students. We discussed in class that higher public expenditure aggravates inequality of schooling by ability. Since we are studying the reverse case, a decrease in resources, it implies that high-ability students would perceive the decrease in resources as a greater reduction in their productivity in human capital production. They used to have an extra boost from the resources (due to their coupling with high ability), but this is now lost. High ability students would thus reduce their optimal schooling by more than low-ability students.

Inequality by ability is *not* worsened by a reduction in expenditures, on the contrary.

While family background (finances) are not part of the Ben-Porath model, we can say that insofar as ability (which is part of the model) is correlated with family background, the budget reduction would also affect inequality in terms of family background. In this case, a supposedly positive correlation of ability and family finances would mean that lower educational resources also *lower* inequality in terms of family background.

We have typically not assumed the two ingredients (student ability and teacher quality) to be perfect substitutes.

(c) On the basis of empirical evidence for schooling quality (not necessarily at the tertiary level), would you expect a significant change in academic outcomes following the reduction in university resources? (Make a link to the literature we covered, and evaluate which findings are most plausible on the basis of their methods, for example.)

Solution:

- We covered the empirical literature of the effects of school quality on academic outcomes. Several papers were more specifically about primary and secondary school, so note that difference if you draw on

them.

- For example, we studied the empirical literature about the effect of classroom size (primary school mostly) on student outcomes. Papers used varying methods:

  1. observational (Hanushek). No clear relationship between school resources (in general, as well as class size) and outcomes. But weak causal argument.
  2. quasi-experimental approach (Woessmann and West with TIMSS data). Using econometrics to take into account school fixed effects and within-school sorting. Problem with weak instrument (weak first stage).
  3. natural experiments/IVs (claim of causality). Examples are Maimonides rule in Israel limiting the maximum classroom size at 40 (Lavy) , or cohort size differences (Hoxby).
  4. randomized experiments (Project Star, Krueger and Whitmore). Advantage of Project Star is randomization, but opt-out of parents? Hawthorne effect? Overall, high quality study that showed positive gains from smaller classroom.

  The (natural) experiments are necessary because we believe that students do not sort randomly into schools and classrooms. We worry that the smallest classrooms have the best (or the worst) students. Then, we would attribute good (bad) outcomes to classsize, even though there may not be a causal relationship, only a 3rd unobserved variable. Whether the effect is causal is important for policy.

- These different papers on class size had contradicting findings (some found significant positive effect of smaller size, others no effect). Therefore, the evidence is not strongly in favor. In terms of our question it would imply that we should *not* expect much worse academic outcomes of students because of the reduction in resources which would lead to squeezing more students into classrooms.

- The general literature on schooling quality also revealed the difficulty to measure school quality. This means that without knowing how exactly the university implements the cuts, we do not know clearly ex ante how outcomes will vary. Also, the very weak empirical role for traditional "resource" measures was pointed out (Hanushek; Dobbie and Fryer). Reducing *financial resources* is not convincingly related to outcomes. Again an argument suggesting that the budget cuts may not have an observable effect on student outcomes, on the basis of empirical knowledge.

- We also studied peer effects in the context of school financing (Benabou model in textbook). A change in the university quality could provoke a change in the composition of students (such as a reduction

in high-ability students, as suggested by the previous question), and this could in turn affect the productivity of all remaining students. The relevant empirical paper in this topic is the peer group assignment paper by Carrell, Fullerton and West. This was a study at the university level. There, we were presented with evidence that low-ability students benefit from the presence of high-ability peers. This would mean that a reduction in high-ability students at university, due to the reduction in resources, could negatively affect outcomes of the middle- and low-ability students. Unfortunately, the sequel paper showed that the external validity, or the ability of economists to predict the human capital production out of the observed range, is more than limited in practice.

2. Now imagine (hypothetically) that the government, instead of asking universities to reduce their budgets, lowered the amount paid to students in form of grants (Danish acronym: SU).
(Note: If you do not know anything about the SU, you may read the footnote for a basic overview,[2] even though these details are not necessary to answer the question. If you are uncertain about the institutional set-up, clearly state your assumption and how it influences your answer. Use Economics of Education in your answer.)

   (a) Would we expect the reduction in financing to lead to a fall in educational attainment because of credit constraints? Remember what we know from the empirical literature.

Solution:

First off, a reduction in student grants leads to higher opportunity costs of schooling. This would then tend to reduce aggregate educational attainment in all classical human capital models. But this question is about an *additional* fall due to credit constraints. Do we expect an additional fall?

We have read empirical papers about the existence of credit constraints.

- Macro paper in the textbook by Checchi: concludes that there are credit constraints that reduce educational attainment.
- Micro papers: mainly Belley and Lochner, which contrasts 2 different datasets. Concludes that there are credit constraints for more recent US cohorts. However, we also mentioned that enrollment does not change much when lowering tuition or providing financing.

[2] The SU grants provide help with living expenses while studying, and are not awarded on the basis of merit or need (they are not limited to high-ability students or children of poor parents). You can assume that in practice, all students at Danish universities qualify for the grant. The length of time for which students can receive it depends on the type of study, with a strict upper limit. The level of grants is reduced if student's own additional income exceeds certain thresholds. If students live with parents, the grant is lower and parents' income has a further influence on the amount received. Details from http://ufm.dk/en/education-and-institutions/grants-and-loans/su-2013-the-danish-student-s-grants-and-loans-scheme.

- This last point could be explained by the Heckman argument that students' college readiness is a function of investments throughout their childhood. Early childhood education produces the human capital that then determines the expected cost (incl. psychic) and returns of college. Implications for inequality extended: only changing tuition at college level does not change the investments their parents have made over the entire multi-period childhood. More effective would be early investments.

- Evaluation of the relevance of Belley Lochner literature: US data versus Danish setting. Tuition is not such an important cost factor in Denmark, rather foregone earnings. Since the question is only about cutting support, not increasing tuition, the evidence from the US setting may be less applicable. Do you expect more credit constraints in Denmark than the US?

3. Consider why most governments subsidize university education.
   (a) What assumptions must governments be making to justify the public subsidization of tertiary education?

Solution:
Reasons for government in education: We had an extensive class discussion on this. In addition, see slides to Lecture 11.

- One main argument is a concern with credit constraints.

  1. These can imply intergenerational effects (parents unable to invest optimally in children). Society may decide that equality of opportunity is a goal in itself, thus subsidies could be used to reduce the dependence of children's investments in human capital from their parents.
     But be careful to distinguish the timing at which "equality of opportunity" is measured: early childhood or at the time of college decision? If interested only in opportunities conditional on age-18-human capital, yes free college generates a more level playing field. But it does not promote equality of opportunities from earlier on.
     Empirically, link this to the observation of *when* investments are most efficient - early investments may be limited because of the particular wage pattern we observe in parents (lower when young, when children are also young).
  2. Another implication is inefficiencies when children/parents have unequal marginal rates of return to investments. There is a potential for Pareto improvement by small redistribution from low-marginal-productivity parents/children to high-marginal-productivity parents/children. Note that the model of dynamic skill formation (Cunha and Heckman, 2007) could inform the point in time when

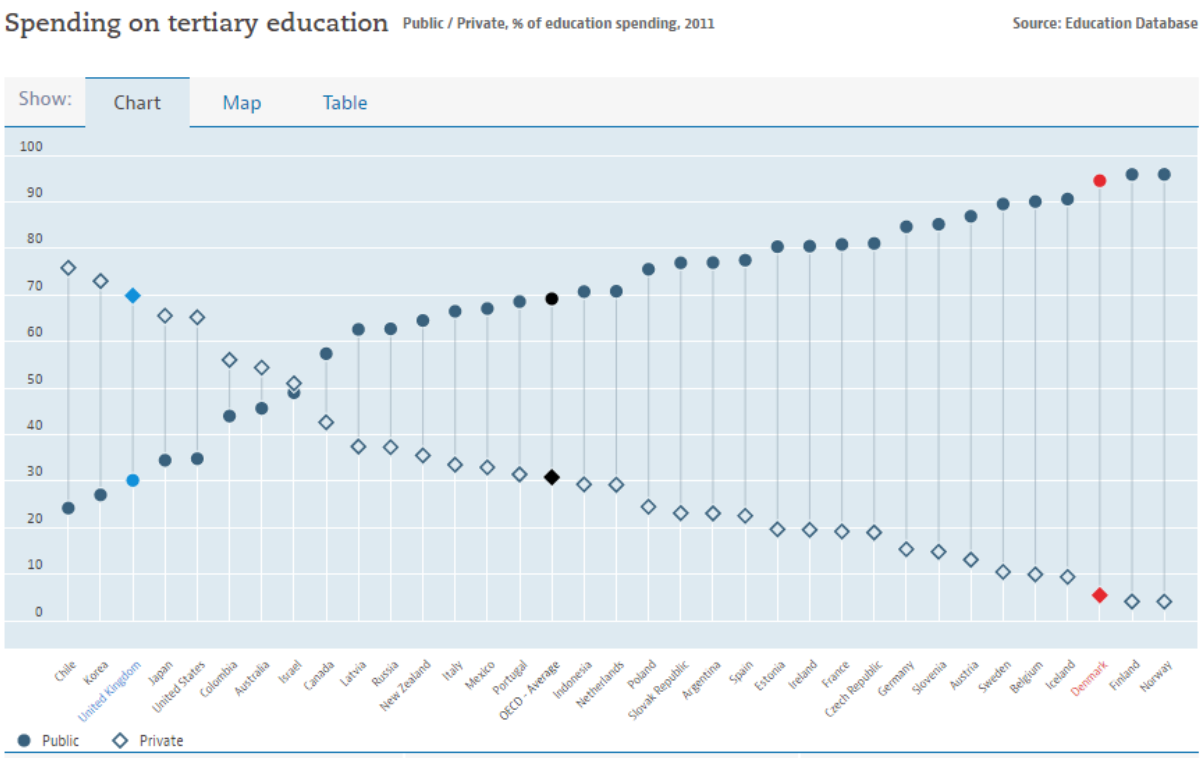
these investments are most efficient. That model clearly states that there is no efficiency/equity tradeoff for early investments (meaning the argument above, that society values equity, may not be necessary).

- Most other explanations are versions of the theme that *private optimality* may not equal *social optimality*. Are social returns to education higher than the private one because of externalities?

  1. Economic Growth. There is evidence that human capital boosts growth of nations in the long run. The role of innovations and research is highlighted by most endogenous growth theories, and can reasonably be linked to higher education (more than primary education). Wherever an innovator does not reap the entire productivity gain from his/her invention, there is a positive externality that the individual will not take into consideration when deciding how much to invest in their own schooling. This positive spillover may occur for example if subsequent generations of innovators can be more productive with the knowledge the original innovator established. Then society may have an interest in subsidizing the development of potential innovators at universities.
  2. Crime is reduced from education (theory by Lochner, empirical evidence by Lochner and Moretti). Most crime is not only a redistribution (such as property moved from the victim to the criminal), but has negative externalities on victims and society, such as policing costs or bodily harm. Society may decide that the savings from reductions in crime outweigh the costs of financing/providing more education.
  3. There is evidence that health improves with education. Causal claims for longevity are made by Lleras-Muney, for example. In order for there to be a positive externality, one must argue that health care systems are social and that the system as a whole benefits from an individual improvement in health, more than only the individual.
  4. Especially when thinking about the second part of this question, we should think about the relationship between private and social returns. Private returns to education are determined by the wage schedule. If institutional factors limit the wage growth from education, for example because of wage compression in the top, strong redistribution through taxes etc., the private returns may not reflect the full productivity gain from education.

- We also mentioned protection of minors, paternalism, common values (all these seem much less relevant to tertiary education).

- Note that a very basic assumption must be that schooling is productive - it increases human capital. If the government believed that education was pure signaling, it would suggest ability tests instead.



Note: This graph shows the division of spending on tertiary education into its private and public constituent parts. The OECD includes the following definition/explanation: "Spending on tertiary education is defined as the total expenditure on the highest level of education, covering private expenditure on schools, universities, and other private institutions delivering or supporting educational services. [...] Expenditure by private companies on the work-based training of apprentices and students is also taken into account, together with spending on research and development by educational institutions."

(b) Follow-up question: Can you use your answer to part 3.a) to comment on why you think the public in Denmark subsidizes tertiary education more heavily than in the United Kingdom or the USA? The graph below illustrates.

Solution:

What can we conclude from the explanations above about how policy makers (or society) sees the benefit from education in the US versus Denmark? In one way or another, Danes must think that either the problem with credit constraints is more severe (or consequential for society), or that social returns exceed private ones by more. It is possible, for example, that the Danish assessment of the importance of human capital for growth indicates a bigger role for human capital than in the US.

Develop your arguments like this, and evaluate which ones you think to be most important.