Written Exam at the Department of Economics winter 2019-20

Health Economics

Final Exam

10. January 2020

(3-hour closed book exam)

(SUGGESTED ANSWERS)

Answers only in English.

This exam question consists of 4 pages in total

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- contact an invigilator who will show you how to register and submit a blank exam paper.
- leave the examination.
- contact your GP and submit a medical report to the Faculty of Social Sciences no later than five (5) days from the date of the exam.

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- Make use of exam aids that are not allowed
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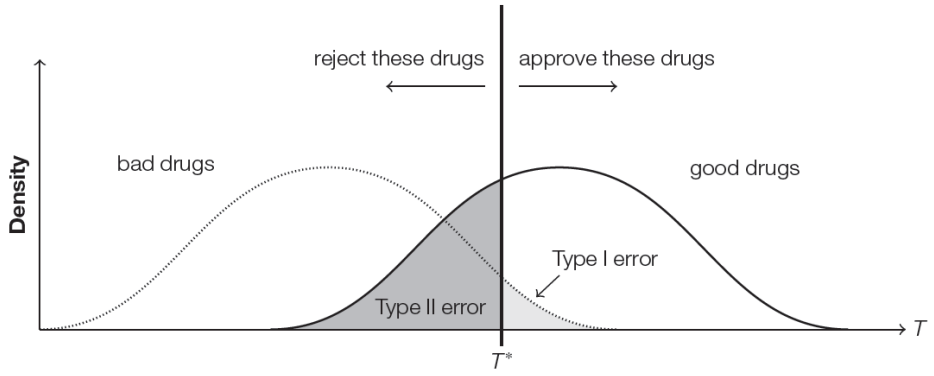
- Copy other people's texts without making use of quotation marks and source referencing, so that it may appear to be your own text
- Use the ideas or thoughts of others without making use of source referencing, so it may appear to be your own idea or your thoughts
- Or if you otherwise violate the rules that apply to the exam

Medical innovations, health and labor supply

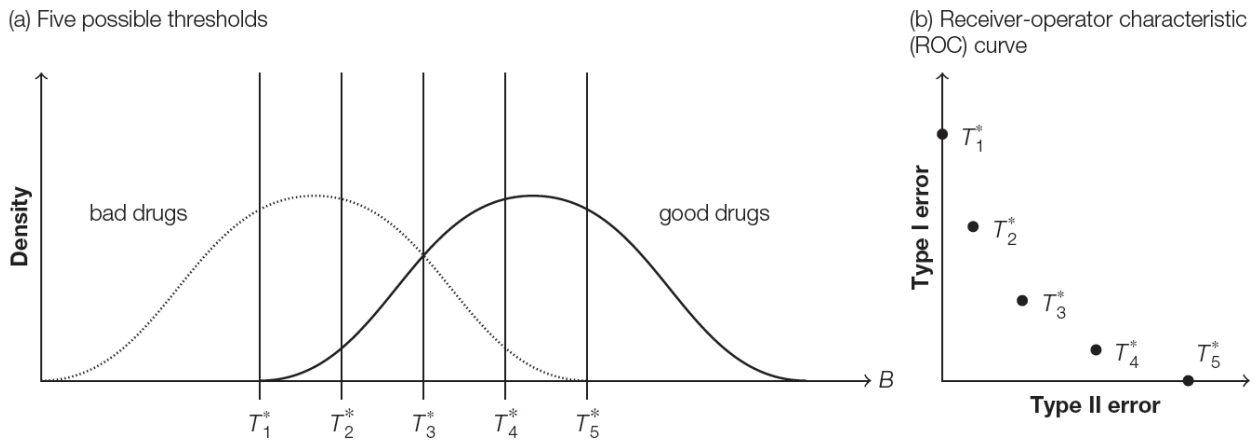
Question 1: Describe trade-offs in restrictive versus permissive regulation of the pharmaceutical market.

Prior to pharmaceutical drugs to being approved for sales they are undergoing three phases of testing: phase 1 to test the drug on healthy individuals and in small doses, phase 2 to test doses to unhealthy individuals and phase 3 to test the effectiveness in preventing disease or medical conditions. If a drug "survives" these three phases phase the FDA (EMA in Europe) approves the drug for sales. However, phase 3 do not have complete information about of the drug, as it may take year until all (adverse) effects are revealed. Provided the restrictiveness of the regulation lead to a general trade off: either bad-drugs can be approved (Type I errors, examples including Thalidomide or Vioxx as described below) or good drugs can be rejected (Type II errors, say delaying of beta-blockers or waterpills). This trade off can be graphed as below showing latent distributions of bad and good drugs. A principal challenge for regulators is to set threshold the T under incomplete information to determine how restrictive it is in allowing sales of specific drug. The further to the right T is placed, the more restrictive the policy is.*



Question 2: Explain why the following statement is true, or provide a counterexample: a receiver-operator characteristic curve, which plots the Type I error of a test against the Type II error from that same test, always slopes downward.

Answer: The statement is true.
No matter what the distribution of bad drugs and good drugs is like, moving the threshold to the right reduces Type I error and increases Type II error. As a result, no receiver-operator curve can slope upward. This is graphed below.



Question 3: Is the following statement True or False? The Food and Drug Administration (FDA) decides whether to approve a drug for use in the U.S. based in part on whether each drug is cost-effective in the treatment of some disease. Elaborate on the answer in one or two lines.

Answer: FALSE. The FDA does not consider cost-effectiveness; drugs must be shown to be safe and effective at treating a certain condition.

Illustration 1: a patient with joint-conditions, such as Arthritis (DK: slidgigt), which causes pain and inflammation in a joint.

Background:

The late 1990's brought new medication to treat joint-conditions (Illustration 1 above, provides an illustration of a patient with joint-conditions). The drugs labeled "*Cox-2 inhibitors"*, a type of "nonsteroidal selective anti-inflammatory drugs" (NSAID), saw the market. Among the Cox-2 drug brands were Vioxx, Bextra and Celebrex. The Cox-2 inhibitors were improving standard treatments with Cox-1 inhibitors, which had shown side effects such as gastrointestinal bleeding (DK: blødninger I mavesækken). In 2002 the FDA required the producer of Vioxx to put a "black box warning" label on the product to inform consumers that

Vioxx had been associated with increased risks of cardiac events (eg. heart attacks). A subsequent study confirmed the risk, and ultimately, in September 2004 the producer Vioxx globally withdrew the product from the market, although the drug had gained immense popularity among patients. Following this withdrawal, the FDA requested producers of Bextra to withdraw this product in 2005. The producer of Celebrex added labeling to the product, which described the cardiac risks.

In an empirical investigation, Garthwaite (2012) asks: What was the effects of Cox-2 inhibitors on labor supply? He relies on data on 55-75 year old Americans interviewed in the Medical Expenditure Panel Survey (MEPS). The survey asks individuals questions over a series of five interview rounds, detailing two years of medical expenditures and services utilization. The study utilizes interviews of the same individuals conducted between 2004 and 2005, i.e., before and after the withdrawal of Vioxx.

Question 4 Explain why a simple cross-sectional association between individual consumption of Cox-2 inhibitors and labor supply would not identify causal relationship.

Answer: There could be a number of confounding effects in such an association. For instance, individuals who take medication may also have a greater desire to work, which would lead to an upward bias. Downward biases could occur if individuals with more severe joint conditions may be both less likely to work and seek prescriptions for a COX-2 inhibitor due to more intense pain.

Consider regression Equation (1):

$$(1) \quad Y_{it} = \gamma_0 + \sum \alpha_j AGE_{it} + \gamma_1 REMOVE_t \times JOINT_i + \mu_i + v_t + \epsilon_{it} \,,$$

where Y_{it} is the outcome of interest (e.g., labor supply or the use of Cox-2 inhibitors) for individual i interviewed in survey round t. AGE_{it} are age fixed effects, μ_i are individual fixed effects, v_t are survey round fixed effects and ϵ_{it} is an idiosyncratic error term. $REMOVE_t$ is an indicator of whether the interview took place after the withdrawal of Vioxx, and $JOINT_i$ is an indicator of whether individual i has been diagnosed with a joint-condition.

Question 5: What is the principal identification strategy behind Equation (1)?

Answer: the principal idea strategy a difference-in-difference estimation, in which γ_1 is the parameter of interest. The treatment group consists of individuals with joint conditions and the control groups are individuals without any such condition. γ_1 captures the treatment groups additional effect on the outcome of interest for joint-patients after introducing further restriction on the sales of COX-2 inhibitors. This captures a causal effect if no other events affect the treatment group differentially from the control at the time of the sales restrictions.
(Note that neither the $REMOVE_t$ or $JOINT_i$ variables are entering the regression as these are captured in the individual and survey round fixed effects.)

Panel 1 and 2 of Table 1 show OLS estimates of the estimation of γ_1 in Equation 1. Panel 3 takes an instrumental variable approach (all estimates are statistically significant):

	Full sample	Males	Females
Panel 1- Outcome: indicator of Cox-2 inhibitor consumption (OLS estimates)	-0.1023	-0.0813	-0.1122
Panel 2 - Outcome: Labor force participation (OLS estimates)	-0.0226	-0.0280	-0.0203
Panel 3 - Outcome: Labor force participation Where Panel 3 = Panel 2 / Panel 1 (given by two-stage-least-squares estimates) First stage (Instrument) is given in Panel 1. Reduced form is in Panel 2.	0.2207	0.3240	0.1805
Observations	12,321	5,514	6,807

Question 6:
What are the effects of the withdrawal of Vioxx on the consumption of Cox-2 inhibitors?

Answer: This effect can be read off Panel 1, and shows a 10 percentage point reduction in Cox-2 inhibitors. This reduction is particularly large for females.

Question 7:
What are the effects of Cox-2 inhibitors on labor supply?

Answer: The reduced form results of withdrawing Vioxx on labor supply is 2.2 percentage points. Translating this into the effects of Cox-2 inhibitors can be read off panel 3, showing that labor supply effects amounts to 22.1 percentage points, which is particularly large for males (32.4 percentage points). This effect can be interpreted as the causal effect of consuming the Cox-2 inhibitors for pain relief. It can also be interpreted as a local average treatment effect: the average labor supply effect of the marginal patient responding to the more restrictive sales regime.

Question 8: Given the Grossman model, explain how technological improvements can lead to increased labor supply.

Answer: The answer may describe the principal building blocks of the Grossman model and graph how technological improvements will lead to an expansion of the production possibility frontier allowing the individual to produce more health capital. This switches the time-constraint in the labor-leisure diagram outwards, allowing the individual not only to work more, but also consume more leisure.

Question 9. Write up the principal formula for the "Incremental cost-effectiveness ratio" between Cox-1 and Cox-2 inhibitors. Given your findings in the previous questions, reflect on the importance of differential inputs in cost-effectiveness analyses of medical innovations.

Answer: The principal formula

$$ICER = \frac{Cost_{Cox2} - Cost_{Cox1}}{Effectiveness_{Cox2} - Effectiveness_{Cox1}}$$

A usual effectiveness analyses would rely on survival probabilities of a disease given treatments with Cox-1 versus Cox-2 inhibitors and weighted with a quality of life adjustment, e.g., the perceived value of pain relief. The higher the ICER is, the more costly is, say, an additional (quality adjusted) life-year. As of 2002, there is a decline in the perceived survival probabilities with Cox-2 inhibitors due to the realization of increased cardiovascular risks using these drugs, leading to an increase of ICER. However, the analysis above also shows a reduction of potential costs (in terms of labor supply) by using Cox-2 inhibitors, making the drug more cost-effective. However, the job of say FDA is not to judge these latter inputs, but only the effectiveness of the drugs, and is hence not used to assess whether or not the drug should be banned.

Question 10: Given papers from the health economics course, to what extent do health shocks affect economic outcomes for patients?

Answer: related to the current analysis, Laird and Nielsen (2016) show that physician leniency of prescribing anti-inflammatories and opioids (as well as anti-depressants and anti-anxiety) affect the probability of taking these drugs, but only opioids affect labor supply, but in a negative direction. The paper identifis these effects using mover's detachment from previous physicians.

The economic consequences of health shocks (measured by hospital admissions) is for the US investigated by Dobkin et al. (2018), who show that earnings and income drops are substantial in the US---even for those with medical bill insurance. Fadlon and Nielsen (2017) show earnings drops in Denmark similar in magnitudes to those in the US. However, in Denmark these drops do not manifest in income losses. Dobkin et al. (2018) suggest that this pattern is driven by more generous availability of Sick-pay in Denmark. Dobkin et al. (2018) also show that the number of medical collections (mechanically) increase after hospital admissions in the US, but medical bankruptcies are limited. Credit limits and balances decline (despite a larger demand due to increased out-of-pocket costs) suggesting that drops in earnings capacities limit the financial liquidity.