Written Exam at the Department of Economics winter 2016-17

Health Economics

Final Exam

December 21st 2017

(3-hour closed book exam)

Please note that the language used in your exam paper must correspond to the language for which you registered during exam registration.

This exam question consists of 5 pages in total

NB: If you fall ill during an examination at Peter Bangsvej, you must contact an invigilator in order to be registered as having fallen ill. In this connection, you must complete a form. Then you submit a blank exam paper and leave the examination. When you arrive home, you must contact your GP and submit a medical report to the Faculty of Social Sciences no later than seven (7) days from the date of the exam.

High expenditure in the health care sector: Provider practice style and patient outcomes

It is highly debated whether high expenditure in the health care sector is waste or if they in fact benefit patients in terms of better health outcomes.

Question 1:
Explain and illustrate how moral hazard could be a driving mechanism of high expenditures in the health care sector, and discuss means to combat moral hazard.

Answer:
Moral hazard in the health care sector arise eg. when insurance coverage lead to changed behavior. We distinquish between ex-ante moral hazard (people change behavior before an insured event happens, e.g, skipping a flu shot) and ex-post moral hazard (changing behavior given insurance coverage once an adverse event have taken place, e.g., requiring more expensive treatment that is otherwise more redundant).

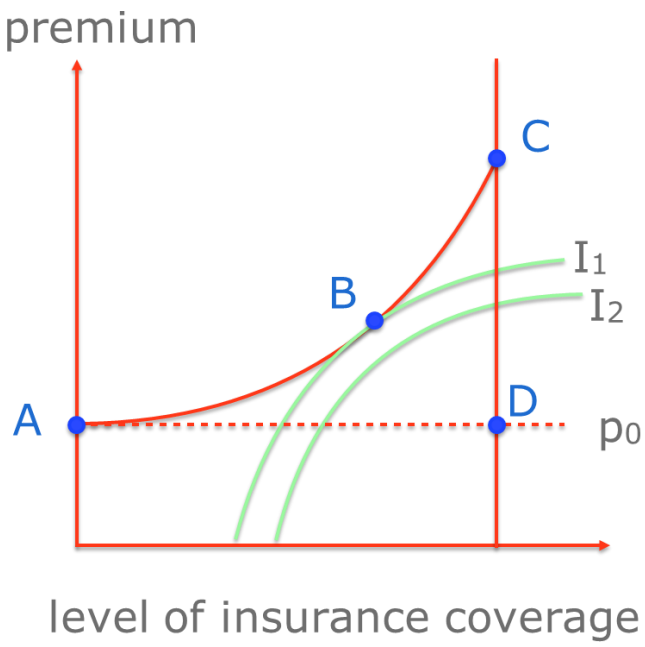
Figure 1 illustrates the Pauly model in a world with and without moral hazard. The x-axis reflects the level of insurance coverage, where the right most vertical line is the case with full insurance coverage. The y-axis is the premium paid and reflect the cost associated with the medical treatment offered. In a world without moral hazard, the premium will be independent of the level of insurance. However, with moral hazard the level of insurance will induce higher expenditure, reflected in the line running through A and C.
Indifference curves are represented by I_1 and I_2. *They reflect that costumers trade off premiums and level of insurance, in which* I_2 *is at a higher level than* I_1.
The equilibrium level of insurance coverage and premiums is at point B (abstracting from adverse selection). In a world with full insurance premiums would lie at point C. In both situations, the costs are higher than a world without moral hazard.

Moral hazard in the market for hospital services could be driven by the choice of treatment that the provider supplies, given they know that the patient is covered by insurance. In that situation, the hospital could provide services that are expensive but not necessarily (or only marginally) benefit the patient.

Traditional means to combat moral hazard include cost sharing such as co-payments or coinsurance, deductibles or monitoring (for instance gatekeeping by GPs). But binding cost-benefit analyses in health technology assessments may also effectively tackle moral hazard by not offering particularly expensive treatments. Queuing and waiting lists are other examples.

Students may elaborate more on different means.

FIGURE 1



A growing body of literature is studying associations between health care expenditure and patient outcomes. A recent paper (Currie et al. 2016) studies how physician practice style affects costs and patient health outcomes. The paper studies 658,553 heart attack patients from Florida admitted via 149 different emergency rooms in 1992-2011. The paper tracks subsequent health expenditure and outcomes of the patients. 2,929 cardiologist (physicians with a heart conditions as their specialty) treated the patients and 59% of the patients were treated with invasive procedures (i.e., treatments that require "aggressive surgery" and are more "expensive" than other types of treatments). Due to side effects for some patients, invasive treatment may reflect medical over-use for some patient types.

To measure physician practice style, imagine that we can construct a "$patient\_index_i$" spanning [0,1], that objectively (given state-of-the-art medical research) determines the appropriateness for a patient, *i*, to receive invasive care. $patient\_index_i$ =0 means that invasive treatment is inappropriate, $patient\_index_i$ =1 means that invasive treatment is appropriate.
For each cardiologist, *j*, we now estimate the parameters α_j and β_j:

$$\Pr(Invasive_{ij}) = F(\alpha_j + \beta_j * Patient\_index_i + \varepsilon_{ij}) \quad (1)$$
$$For\ each\ j=1,\ldots,J$$

This provides two measures of physician-practice-style:
α_j capturing physician **Aggressiveness,** ie., the propensity for physician, j, to choose invasive treatment on the median patient.
β_j capturing physician ***Responsiveness***, ie., the propensity that physician j choose invasive treatment for patients for whom it is more appropriate

Table 1 summarizes the probabilities of the patients receiving invasive treatment for *All* patients, as well as for the 1/3 of patients for whom invasive treatment is *less appropriate* and for the 1/3 of the population for whom invasive treatment is *more appropriate*.

Table 1 *Descriptive statistics*

	All patients	**Patients with Low appropriateness for invasive procedure**	**Patients with High appropriateness for invasive procedure**
Patient probability of invasive procedure	59%	28%	86%
Total hospital cost per patient	$19,380	$16,601	$20,099
Percentage of patients that died in the hospital	10%	17%	4%

Next, we construct dummy-variables for physicians that indicate whether their *responsiveness* is low (*Low_responsiveness*$_j$, meaning that β_j is significantly below zero) or not; and whether their *aggressiveness* is low (*Low_aggressiveness*$_j$, meaning that α_j is significantly larger than zero), intermediate (α_j is not significantly different from zero) or high (*High_aggressiveness*$_j$, meaning that α_j is significantly larger than zero). Consider the following regression model:

$$Y_{ij} = \phi_1 * Low\_responsiveness_{ij} + \phi_2 * Low\_aggressiveness_{ij} + \phi_3 * High\_aggressiveness_{ij} + \Pi Z_j + \Omega X_i + \rho patient\_index_i + \varepsilon_{ij} \quad (2)$$

Y_{ij} is an outcome measure of interest for patient *i* treated by cardiologist *j*. Such an outcome could be *total hospital spending* for the admission or *patient death* in the hospital.
Z_j is a vector of physician characteristics, such as age, gender, seniority and the medical school the physician graduated from, X_i is a vector of patient characteristics such as age, gender, whether the patient had a previous heart attack or other comorbidities and ε_{ij} is an error term.

Question 2:
Consider equation (2) where the outcome variable is death at hospital, ie., Y_{ij} =1 if the patient died in the hospital and Y_{ij} =0 otherwise. What are the interpretations of the signs of the parameter estimates of ϕ_1, ϕ_2 and ϕ_3 ?

ANSWER:
The parameter estimates captures the effects of physician practices style on patient outcomes. Generally, negative signs reflect that the practice style under consideration (responsiveness to appropriateness and aggressiveness) would be beneficial for the patients.
Hence, ϕ_1 *<0 would reflect that if doctors are more responsive to the appropriateness of the treatment for the given patient, then mortality rates will decline.*

The reference group of physicians in terms aggressiveness are the average physicians. Therefore,

$\phi_2 > 0$ means that those of lower aggressive practice style increases mortality. Contrary, $\phi_2 < 0$ means that low aggressive practice style decreases mortality.
$\phi_3 > 0$ means that high aggressive practice style increases mortality, $\phi_3 < 0$ means that high aggressive practice style decrease mortality, and, hence, is more beneficial for the patient.

Table 2 reports the estimated parameter estimates of equation (2) on subsamples of patients for whom invasive procedures had low and high appropriateness respectively.

Table 2 *Parameter estimates of ϕ_1, ϕ_2 and ϕ_3 in equation (2)*

	Patients with Low appropriateness for invasive procedure			**Patients with High appropriateness for invasive procedure**		
Outcome:	Invasive procedure	Died in Hospital	Total Cost	Invasive procedure	Died in Hospital	Total Cost
Low responsiveness, ϕ_1	0,08	-0,009	0,05	-0,08	0,005	-0,07
Low aggresiveness, ϕ_2	-0,11	0,007	-0,08	-0,09	0,007	-0,11
High aggresiveness, ϕ_3	0,17	-0,017	0,13	0,05	-0,005	0,09

Note: The table reports parameter estimates of equation 2. All results are statistically significant.
Controls include: patient appropriateness index, patient age categories and gender, previous heart attacks, patient comorbiditities, and physician characteristics.
Total costs are measured as an index spanning]0;1] and captures the individual patient's percentile in the "total cost" distribution. Ie., Total costs $\underline{\sim}$ 0 for the patient with the lowest associated costs, and Total costs = 1 for the patient with the largest costs.

Question 3:
Given the results in Table 2, explain the relationship between outcomes for patients with high appropriateness for invasive procedures and physician practice style.

Answer:
Columns 5-7 shows the results for patients of high appropriateness. In terms of physician responsiveness, the table shows that low-responsiveness reduces the probability of invasive procedures by 8 percentage points and have lower costs associated to the hospitalization, too. This is what we would expect. But the table also shows that this is in fact increasing mortality risks.
In terms of aggressiveness the table shows that the more aggressive the physician, the more costly the admission, yet, it does in fact improve survival prospects.

Question 4:
Does the relationship between patient outcomes and physician practice style for patients with high appropriateness apply to patients with low appropriateness, too? Explain

ANSWER:
Qualitatively, the patients with low appropriateness are similar to those with high appropriateness

given the estimated signs of ϕ_2 and ϕ_3 (related to physician aggressiveness). However, the sign flips when we study the effects of responsiveness. The latter is actually, what we would expect for the probability of receiving invasive treatment and the associated costs. More appropriate treatment for this group of patients would be less invasive treatment. With that in mind, it is therefore surprising that mortality risk declines for this group.

Question 5:
Would you recommend that cardiologists change practice style in their treatment of heart attack patients? Explain

ANSWER:
One could argue that physicians generally could increase their probability of providing invasive treatment.
Given the answers to questions 3-4 it seems that increasing invasive treatments is beneficial not only for the patients where the appropriateness index is high, but also (on average) for those, for whom state-of-the-art research would not recommend invasive treatment. However, such an increase would also come with increased cost.
It turns out that more aggressive physician practice style benefits both low and high appropriateness patients. Moreover, if the doctors are less responsive to the patient index (which we could think of as the medical guidelines) it benefits the patients with low appropriateness, but not those of high appropriateness, indicating that more invasive treatment is better.

Question 6:
Sketch identification strategies that the literature (from the health economics course) used to determine the returns to medical spending. What were the general findings?

Answer:

A main concern in the literature is patient selection into specific suppliers and large spending due to moral hazard, which would lead to biased estimates towards zero in the relationship between spending and health outcomes.

Doyle (2011) studies heart attacks patients in Florida and investigates whether variation in costs across hospitals manifest in better health outcomes, specifically, mortality rates. The study is unable to find strong evidence of an association costs and patient outcomes among local Floridian's. One good explanations for this is that hospitals may fit the treatments to the traits of the local population. Consequently, it is hard to detect any effects.
To circumvent the problem the paper studies visitors to Florida that experience heart attacks during their stay. Under the identifying assumption that it is as good as random which hospital the visitors are admitted to the paper finds that higher expenditure are associated with better health outcomes.

Doyle et al. (2015) gets to similar overall result (better outcomes for high spending suppliers) for admission of patients with non-deferral diagnoses. The identification strategy relies on a rotational scheme in which ambulance companies are assigned to pick up patients in different geographical zones in New York at different times. It turns out that different companies varies in their tendency to drive patients to specific hospitals different characteristics in terms costs profiles. Given the timing of the shock of the patient is orthogonal which ambulance company that is on duty the estimates are

unbiased. In another identification strategy, they exploit how patients living close to, but on each side of hospital referral-zones, has different outcomes. Again the paper finds a positive causal effect of hospital spending on patient outcomes, supporting the evidence that more costs are also associated with better outcomes.

Finkelstein et al. (2016) studies sources of geographical variation in health expenditure, by looking at the MediCare populations (age 65+) that move across hospital referral zones in the US, and investigate how much of the cost profile of the place of origin determines spending in the place of destination. In that, way they are able to break down how much of the variation that stems from supplier versus demand side effects. While this paper doesn't inform about patient outcomes, it reveals some of the underlying reasons behind differential costs. Particularly, the study finds that 50-60% of the variation in costs are driven by supplier characteristics.

None of these papers are able to nail exactly which underlying mechanism that drives these seemingly important supplier sides effects.

The paper studied in questions 2-5 combines these literatures documenting that an important channel is the physicians' practice styles.

US Health Policy

In the following, the terms "Patient Protection and Affordable Care Act" and "Obamacare" refer to the health care reform passed by the US Congress in March 2010, at the time when Barack Obama was President of the USA.

Question 7:
Outline and describe briefly the main fundamental institutions in the US Health care sector that secured health insurance coverage in the pre-Obamacare era.

Answer:
*Historically, the American health insurance landscape has been relying on **employer based insurance**. Health insurance is thus an important part of total compensation, and empirically associated costs of frail individuals have passed through to lower wages.*

*Some part of the population without employer-based insurance are covered by one of two major public schemes: **MediCare**, universal health insurance for the 65+, and **MedicAid**, health insurance of the poor. The latter scheme is administered at the state level and varies in generosity.*

50-60 million Americans fell out of the eligible categories leaving them uninsured.

The market by-and-large followed free market principles.

The students may elaborate with more detailed information about the above mentioned institutions.

Question 8:

Describe the overall principles for how the Patient Protection and Affordable Care Act intended to expand insurance coverage. (Hint: You may want to use the analogy of the "three legged stool" to organize you description)

Answer:
As outlined by Jon Gruber, the affordable care act can be viewed as "three-legged-stool" that facilitates a larger level of insurance coverage across the population.

1st leg is to ***prohibit insurance companies from denying costumers with pre-existing conditions.*** *In that sense uninsurance due to observable bad health becomes prohibited by law. Given community rating this will drag insurance premiums up becomes more frail individuals enter the insurance pool.*

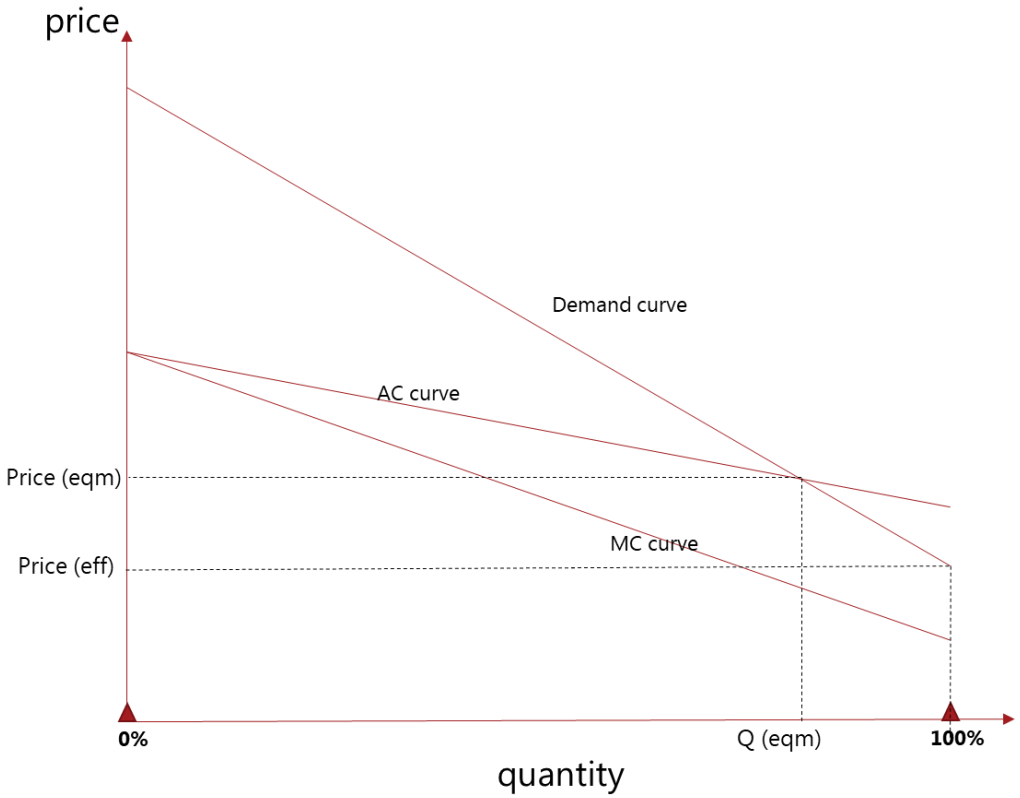
2nd leg is the ***individual mandate****. Like Bismarckian countries, Americans are with this element obliged to buy a health insurance. Under some assumptions (see answer to question 10 for elaboration) that could circumvent adverse selection issues in which robust individuals are refusing to buy insurance, which would otherwise drive health insurance prices up. The individual mandate is implemented by giving tax penalties to individuals that refuse to buy insurance.*

3rd leg is the ***expansion of MedicAid****. The purpose is to provide more insurance for those who otherwise couldn't afford it. This part of the legislation has been more difficult to control from the federal level, because of its administered at the state level.*

Question 9:
Given a standard framework of adverse selection in health insurance, show graphically and explain the equilibrium and efficient prices and quantities in a non-regulated insurance market.

Answer:
Figure 1 illustrates the a standard adverse selection framework in health insurance. The downward sloping demand curve reflects each individual's willingness to pay, and is constructed by ordering people from the person who are most willing (where the demand curve crosses the y-axis) to the person least willing to pay in the right most part of the diagram.
The marginal cost (MC curve) is also downward sloping, because those who are more willing to pay for insurance are also expected to be more frail, hence, inducing higher costs on the insurance company. In the framework there is asymmetric information, meaning that individual health is private information such that the insurance company cannot tell costumers apart in terms of their risk of falling ill. Consequently, the price of the insurance is given by the intersect between the average cost curve (AC curve) and the demand curve.

FIGURE 1



The equilibrium price is consequently higher than the efficient price (where the demand crosses MC), in this case the entire population is covered. Also, the equilibrium share of the population covered is lower than the efficient part (100%). Those uninsured are the more robust individuals.

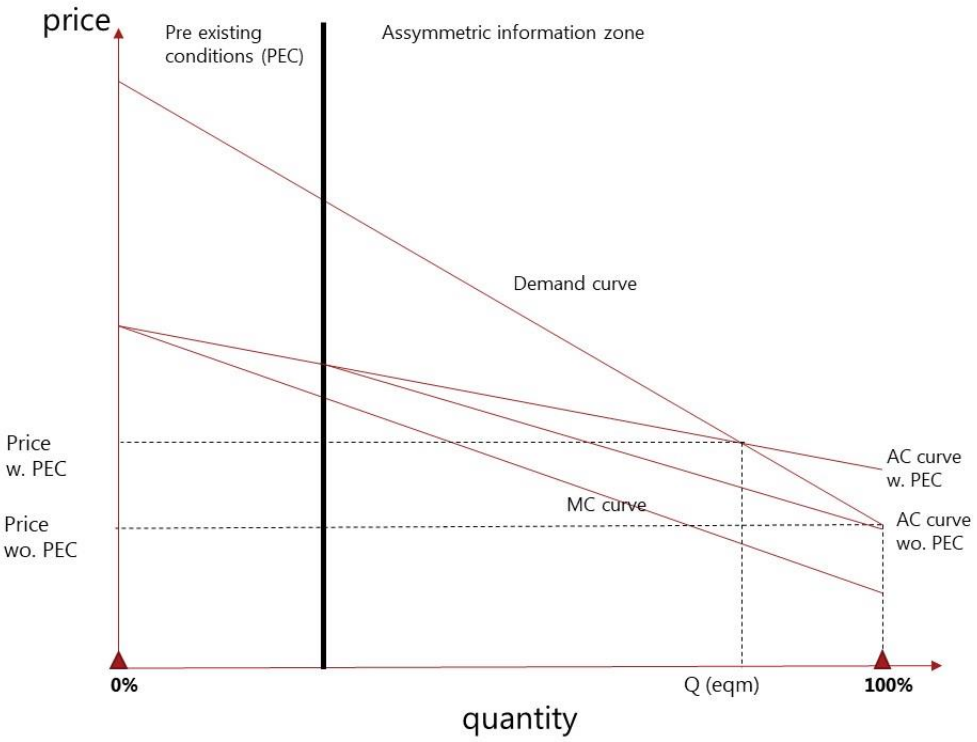
The text in the box below is a quote from the current American President's (Donald Trump) election campaign on his ambition to repeal the Patient Protection and Affordable Care Act (ObamaCare)

> As it appears ObamaCare is certain to collapse of its own weight, the damage done by the Democrats and President Obama, and abetted by the Supreme Court, will be difficult to repair unless the next President and a Republican congress lead the effort to bring much-needed free market reforms to the healthcare industry.
> But none of these positive reforms can be accomplished without Obamacare repeal. On day one of the Trump Administration, we will ask Congress to immediately deliver a full repeal of Obamacare.
> However, it is not enough to simply repeal this terrible legislation. We will work with Congress to make sure we have a series of reforms ready for implementation that follow free market principles and that will restore economic freedom and certainty to everyone in this country. ***By following free market principles*** and working together to create sound public policy that ***will broaden healthcare access, make healthcare more affordable and improve the quality of the care available to all Americans***.

Question 10:
Given the standard "textbook" framework of adverse selection presented in Einav and Finkelstein (2011), analyze challenges the current American President will meet to "broaden healthcare access, while making health care more affordable and improving the quality of the care available to all Americans by following free market principles". Illustrate your analysis in a diagram.
(Hint: you may extend the illustration from question 9)

Answer:
Figure 2 illustrate a world where insurance companies can exclude people with pre-existing conditions. In this example, this is illustrated by the people in the zone to the left of the bold vertical line. This means that the AC curve is shifted downwards in the "asymmetric information zone" to the right of the vertical bold line. Consequently, given free market principles the market price will fall and make health care more affordable. Yet, insurance is no longer covering the entire population, because those without preexisting conditions are without insurance. If they were to be included (first leg of Affordable Care Act), the AC curve would switch upwards, potentially to a level where the most robust individuals would leave the insurance pool. In that case we would have under insurance of the robust, potentially leading to an adverse selection death spiral. The individual mandate in in the Affordable Care Act limits this concern.
Of course the analysis hinges on some assumption. E.g., the demand curve may lie above the AC curves everywhere. That would reflect a world of very risk averse individuals. In that world the robust individuals would be willing to stay in the pool even with individuals with pre-existing conditions that would otherwise drive prices up.
Yet, the example clearly state some of the theoretical challenges the current president will face if he wants to repeal ObamaCare under the conditions describe in his election campaign.

FIGURE 2


price
Pre existing conditions (PEC)
Assymmetric information zone
Demand curve
Price w. PEC
Price wo. PEC
AC curve w. PEC
MC curve
AC curve wo. PEC
0%
Q (eqm)
100%
quantity