Written Exam at the Department of Economics winter 2017-18

Health Economics

Final Re-Exam SUGGESTED ANSWERS

February 20, 2018

(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 6 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.

Part 1: The legacy of Barker

Question 1:
Explain the fetal origins hypothesis (FOH) and its predictions for effects of pregnant mothers' health behavior on their children's health outcomes at different stages of their life cycle.

ANSWER:
FOH, first suggested by epidemiologist David J Barker, states that exposure to adverse conditions in utero can shape health outcomes later in life. Barker's work, for instance, showed that adverse conditions in utero only affected the cardiovascular risk when people were in their 40s or 50s. Critiques, however, stated that these results only revealed correlations, rather than a causal link.

Yet, Barker's work, lead to the fetal origins hypothesis which could be summarized into three elements:

1) *The effects of fetal conditions are persistent*
2) *The health effect can remain latent for many years*
3) *Reflects a, not fully understood, mechanism of fetal programming through epigenetic effects through the environment.*

Many studies, also within health economics, has studied the causal effects of fetal exposure on child and adulthood outcomes. For instance, the Dutch hunger during WWII lead to increased risk of mental health illness in adulthood and lower birth weight of the children in utero during the winter of 1944 as Nazi Germany sieged the Netherlands and blocked food supplies to enter the country. Still, birth weight may be incipient of the latent health effect: later studies of the Dutch winter hunger showed that birth weight was unaffected by children in the early stages of pregnancy during the siege, but had more heart failure later in life.

Bharadwaj et al. (2014) study the impact of a smoking ban in Norwegian bars and restaurants introduced in July 2004. They examine the birth outcomes of children of female workers who were affected by the smoking bans in the workplace. They compare outcomes, Y_{ijt} (eg., whether the mother quit smoking and birth weight of her child) for women, i, in different occupations, j, (the treatment group works in a bar or a restaurant and the control group works in a store) gave birth at different times, t, and estimate the following equation:

$$Y_{ijt} = \alpha_1 + \alpha_2 Treat_j + \alpha_3 Post_t + \alpha_4 (Treat_j * Post_t) + \alpha_5 X_{ijt} + \epsilon_{itj} \qquad (1)$$

$Treat_j$ =1 means that mother works in a bar or a restaurant in 2003 and $Treat_j$ =0 means that she works in a store. $Post_t = 0$ indicates whether the mother gave birth prior to the reform and $Post_t = 1$ means that the woman gave birth after the reform. X_{ijt} is a set of control variables.

Question 2:
Imagine that the outcome of interest, Y_{ijt}, is the child's birth weight. What is the interpretation of the sign of α_4 in equation (1)?

ANSWER: equation (1) is a standard differences-in-differences setup in which α_4 is the parameter estimate of interest. A positive sign reveals that smoking bans would have favorable effects on birth weight for the child.

Estimating equation (1) the authors find that the reform leads to a reduction in smoking probability by 9-52 percentage points for pregnant women working in bars/restaurants compared to pregnant women working in stores. Table 1 reports the estimated results of α_4 for three different measures of birth weight of the child: 1) Birth weight in grams (Columns i and iv), 2) an indicator of birthweight being below 1500g (Columns ii and v), and 3) an indicator of birthweight being below 2500g (Columns iii and vi). Columns (i)-(iii) show the results for women who smoked at the start of their pregnancies and Columns (iv)-(vi) show the results for women who did not smoke at the start of their pregnancies.

Table 1 estimates of α_4

	Women smoking at start of pregnancy			**Women not smoking at start of pregnancy**		
		Indicators for low birthweight			Indicators for low birthweight	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	Birth weight (BW)	bw<1500g	bw<2500g	Birth weight (BW)	bw<1500g	bw<2500g
$Treat_j * Post_t$	165.4**	-.018*	.008	7.86	-.006	.003
N	793	793	793	2554	2554	2554

Notes: * significant at 10% level, **significant at 5% level

Question 3:
Given the results in Table 1, how would access active versus passive smoking during pregnancy to affect birth outcomes of the child?

ANSWER: Columns (i)-(iii) reveals the effects of smoking bans on birth outcomes for active smokers. Those mothers (note that the study reveals that the smoking ban caused these women to smoke less during their pregnancy) had substantial and large effects on their child's birth outcomes. On average the babies weighed 165.4 grams more as a consequence of the reform. This is a large effect (4-5%) if the normal birth weigh is say 3500 grams. However, it doesn't affect significantly the probabilities of being "low birth weigh" (2500 gram) or very low birth weigh (1500 g).
Columns (iv)-(vi) could be interpreted as the effects of passive smoking. The results show no significant effects (precise zero) on birth weight outcomes for non-smoking women, who no longer were affected by costumers smoking in bars and restaurants.

Question 4:
Referring to the empirical results from papers in the health economics course, explain and discuss

how you expect birth weight to affect the long run outcomes of the children, who were exposed to maternal smoking during pregnancy.
ANSWER:
Black, Devereux and Salvanes (2007) studied the effects of birthweight on adult outcomes. They use a twin-study research design in which differences in twins' birth weigh is used to identify the effects of birth weight on adult height, earnings and education. They find that birth weight does matter for these outcomes.
Eg. a 10% increase in birth weight would increase earnings by 1%, equivalent to an increase in education by a quarter of a year.
Extrapolating these results to Bharadwaj et al. (2014) suggests that smoking reductions during pregnancies will have favorable effects on the adult outcomes, too, of the next generations.

Question 5:
Two studies from the health economics course both use administrative data from Scandinavian countries to access whether stress during pregnancy affects children outcomes at different stages of their life cycle. How do these studies identify maternal stress and how do the studies' results differ?

ANSWER:
Persson and Rossin-Slater (2016) (on Swedish data) and Black, Devereux and Salvanes (2016) (on Norwegian data) both study how maternal stress during pregnancies affect child outcomes. Both studies use death in near family during pregnancies to identify an episode of greif (stress) during the pregnancy.
Both studies find small effects on birth outcomes of the children (11 grams lower BW in Sweden and 23 grams in Norway). However, they differ in their ability to reveal longer run effects. The Sweden study finds adverse effects on mental health outcomes during childhood. The Norway study is unable to find any significant results in later life.

The answers may discuss some of the identification problems that the studies met. Eg., a death event in the family during pregnancy may also be a associated with an income or wealth shock. Older mothers may be at higher risk of experiencing death in the family during pregnancy. The window of the shock may be important (concievement date vs. birthdate).

Now, consider the following constant elasticity of substitution production function for health in adulthood:

$$H_{adult} = A[I_{prenatal}^{\theta} + (1-\gamma)I_{postnatal}^{\theta}]^{1/\theta} \qquad (2)$$

H_{adult} represents health in adulthood, $I_{prenatal}$ is in utero investments in health and $I_{postnatal}$ is health investments that take place after birth, θ is the elasticity and A reveals economies of scale .

Question 6:
Write up the investment equation from the Grossman model. Compare the predictions from the Grossman model and equation (2) on how adverse maternal health behaviors during pregnancies affect her child's health in adulthood.

ANSWER:
The health investment function in the Grossman model:
$H_t = (1-\delta)H_{t-1} + I_t$

Health at time t in the Grossman model is a stock variable, H_t, that depreciates by δ from one period to the next, and increases by health investments, I_t.
Adverse maternal behavior in utero can be interpreted as a negative shock to the health stock. Given the depreciation mechanism in the Grossman model this shock will eventually fade out. This is not in accordance with the fetal origins hypothesis that states that in utero shock are persistent and may even remain latent through adolescence and early adulthood.
Equation (2) on the other hand suggests that investments at different times persist into adulthood.

Question 7:
Given your answers to questions 1-7, discuss whether and how you expect smoking bans affecting one cohort of mothers to spillover to their children's health and economic outcomes in adulthood.

ANSWER:
To sum up questions 1-6.
Smoking bans seem to affect maternal smoking during pregnancy. The effects of smoking are striking on active smoking, but passive smoking doesn't seem to affect child outcomes. The effects from active smokers are large compared to say exposure to stress/grief during pregnancies. Given results from the literature, the effects of birth outcomes may transmit to adulthood outcomes that are more favorable. Hence, smoking bans affects maternal smoking behavior that is minimize an externality that maternal behavior impose on child outcomes.
If birth weight is in fact incipient of later life outcomes as some studies suggests, the results by Bharadwaj et al. (2014) may not reveal all the beneficial later life outcomes of smoking bans.

The fetal origins hypothesis has been proven strong in the literature. Given the Grossman model's inability to embed the fetal origins hypothesis, we urge for alternative models, such as the one stated in equation (2) to understanding the health accumulation process. The functional form of the production function allow for special types of technologies in which, for instance, pre- and postnatal investments are complements. That is, favorable prenatal conditions may foster postnatal health investments to be more effective.

Part 2: Health Insurance Innovations

In the textbox below you will find a description of an insurance product (a "smart watch contract") from Aetna (a large health insurance company) in which insurance customers are freely provided with a smart-watch. The insurance company describe the virtues of the product to help "guiding costumers through health events", medicine adherence and personalize their health plans. Beyond these benefits, the costumer also shares his or her health information with the insurer.

Aetna to Transform Members' Consumer Health Experience Using iPhone, iPad and Apple Watch

Launches New Customer Program featuring Apple Watch

HARTFORD, Conn.--(BUSINESS WIRE)--Sep. 27, 2016-- Aetna today announced a new initiative to revolutionize members' consumer health experience by combining the power of iOS apps and the unmatched user experience of Apple products including Apple Watch, iPhone and iPad with Aetna's analytics-based wellness and care management programs. Beginning this fall, Aetna will make Apple Watch available to select large employers and individual customers during open enrollment season, and Aetna will be the first major health care company to subsidize a significant portion of the Apple Watch cost, offering monthly payroll deductions to make covering the remaining cost easier.

With support from Apple, Aetna is planning several iOS-exclusive health initiatives, starting with deeply integrated health apps for iPhone, iPad and Apple Watch that will significantly improve the ability of consumers to manage their health and increase healthy outcomes. The initial solutions under development are among the first health apps designed for multi-device use.

Aetna's iOS-exclusive health apps will aim to simplify the healthcare process through a number of features, including:

- Care management and wellness, to help guide consumers through health events like a new diagnosis or prescription medication with user-driven support from nurses and people with similar conditions.
- Medication adherence, to help consumers remember to take their medications, easily order refills and connect with their doctor if they need a different treatment through their Apple Watch or iPhone.
- Integration with Apple Wallet, allowing consumers to check their deductible and pay a bill.
- Personalized health plan on-boarding, information, messaging and decision support to help Aetna members understand and make the most of their benefits.

Source: http://investor.aetna.com/phoenix.zhtml?c=110617&p=irol-newsArticle&ID=2206242

Question 8:
How do you expect a "smart watch contract" to affect different types of moral hazard for the customers?

ANSWER:
Moral hazard occurs when insurees change behavior due to insurance coverage. We can distinguish between ex-ante and ex-post moral hazard.

Ex-ante moral hazard: Behavior changes that occur before an insured event happens and make that event more likely.

Ex-post moral hazard: behavior changes that occur after an insured event happens and make the recovery more expensive.

The "smart watch contract" will provide the insurance company the patients' health data that would be unavailable with other contracts. This potentially allows the insurance company remove information asymmetries about the patient's health and behaviors. Hence, it could potentially remove ex-ante moral hazard. Helping the patient with, say, medication adherence could be an example as such.

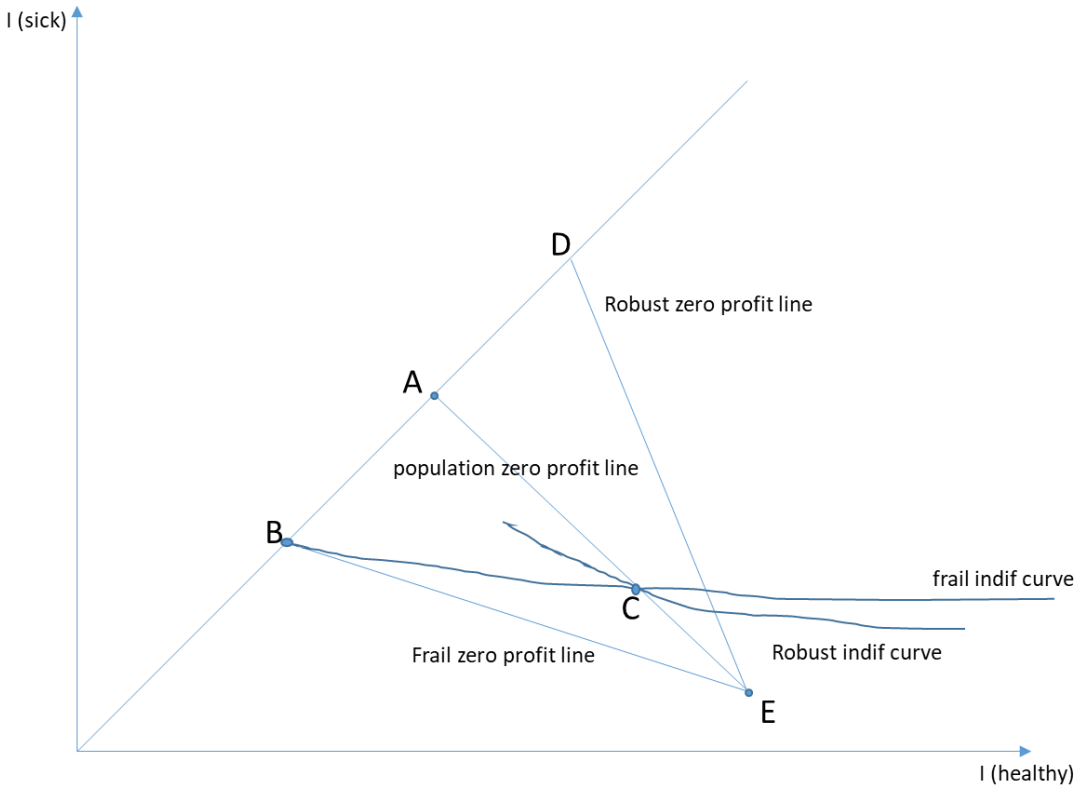
Ex-post moral hazard could potentially be affected, too. The insurance company frames it as "Care management and wellness, to help guide consumers through health events like a new diagnosis or prescription medication with user-driven support from nurses and people with similar conditions." In that sense, the insurance company will have more information about the patient's true health conditions and potentially avoiding overutilization of care.

Now, assume that population of potential insurance customers consists of individuals with differential risks of falling ill. Without a technology like the smart watch, the insurance company have no means to distinguish between their customers in terms of their risk profiles.

Imagine that a pool of customers work at the same workplace (no government contract is offered if the employee leaves the firm). All employees are initially covered by the same insurance contract and pay the same premium. Then, each November every year, the "smart-watch contract" is offered to any employee in the firm who voluntarily wants to sign up for it. The premiums of the different contracts are determined separately and are actuarially fair.

Question 9:
Abstract from moral hazard effects and illustrate graphically a standard framework of adverse selection in the health insurance market. Explain how you expect the insurance premium to evolve and the characteristics of population to change in the existing contract after the option to choose the "smart-watch contract" is introduced.

ANSWER:
The figure below shows a standard Rothschild Stiglitz model of adverse selevtion.
The economy consist of frail and robust individuals with differential probability, p, of falling ill. The x-axis shows income in a healthy state the y-axis is health in a sick state. In a world without insurance the individuals will be in endowment situation, E, in which the individual will receive higher income in the health state compared to the sick.
In a world with insurance, the individual can give up income in the health state (a move to the left in the x-axis corresponding the insurance premium), to receive higher income in the sick state (an upward on the Y-axis. If an individual is on the 45-degree line running through origo, the individual is fully insured.
The line segment AE is the zero profit line for the insurance company given the population probability of falling ill. The slope of the zero profit line is (1-p)/p, hence, the lower p the steeper the zero profit line. Consequently, the zero profit line for the robust individuals, DE, is steeper for the robust individuals than for the frail individuals, BE.
In this standard framework there exist no contract that will voluntarily attract both robust and frail individuals while the insurance company will receive at least zero profits. However, in some very specific situation with sufficiently few robust individuals a separating equilibrium can exist, where robust individuals are attracted to different contracts, this situation is illustrated by points B and C in the diagram. B will attract frail individuals, while C will attract robust individuals.



In a world with symmetric information, the insurance company can efficiently offer contracts B and D in which robust individuals pay a lower premium than the frail. In the workplace under consideration all employees will initially be mandated the same contract initially, say, A.
When the smart watch contract is offered on a voluntary basis, the robust individuals will have an incentive to go for that contract and reveal their type. Hence, the smart watch contract will

converge to contract D (declining in premium and increase in coverage) and the initial contract will become more expensive and only attract the frail individuals (converging towards B).

Question 10:
Imagine that the firm forces all its employees to buy the "smart watch contract" and all employees pay the same premium. Assume that any employee can switch jobs to another firm that offers the initial insurance contract. Would you expect all the employees to stay in the firm? Explain

To be in point A initially, the robust individuals must be willing to subsidize the frail via the insurance program. For instance via wage pass-through (the frail are offered lower wages than the robust). If the frail individuals are to stay in the firm in the situation sketched in question 9 (not switching workplaces) they could be compensated by higher wages.
Similarly, if the smart watch contract is mandated to all, the robust individuals could be compensated eg. via wage pass-through.