Written Exam for the B.Sc. in Economics winter 2014-2015

Økonometri B/Econometrics B

Take-home exam

January 3-4, 2015

This exam question consists of 10 pages in total.

Please note that the language used in your exam paper must correspond to the language of the title for which you registered during exam registration. I.e. if you registered for the English title of the course, you must write your exam paper in English. Likewise, if you registered for the Danish title of the course or if you registered for the English title which was followed by "eksamen på dansk" in brackets, you must write your exam paper in Danish.

If you are in doubt about which title you registered for, please see the print of your exam registration from the students' self-service system.

Focus on Exam Cheating

In case of presumed exam cheating, which is observed by either the examination registration of the respective study programmes, the invigilation or the course lecturer, the Head of Studies will make a preliminary inquiry into the matter, requesting a statement from the course lecturer and possibly the invigilation, too. Furthermore, the Head of Studies will interview the student. If the Head of Studies finds that there are reasonable grounds to suspect exam cheating, the issue will be reported to the Rector. In the course of the study and during examinations, the student is expected to conform to the rules and regulations governing academic integrity. Academic dishonesty includes falsification, plagiarism, failure to disclose information, and any other kind of misrepresentation of the student's own performance and results or assisting another student herewith. For example failure to indicate sources in written assignments is regarded as failure to disclose information. Attempts to cheat at examinations are dealt with in the same manner as exam cheating which has been carried through. In case of exam cheating, the following sanctions may be imposed by the Rector:

1. A warning
2. Expulsion from the examination
3. Suspension from the University for a limited period or permanent expulsion.

The Faculty of Social Sciences
The Study and Examination Office
October 2006

Practical instructions for the take-home exam

- Start by ensuring that you can access the data (see next page).
- The exam can be answered in groups of a **maximum of 4 students**. Hand in a single exam answer for the entire group **and specify each group member's contribution to the exam paper**.
- Read through all the tasks before you start to respond. Reply to all questions in Problems 1 through 6. As a rule of thumb for the distribution of work effort, you can use the following weights:

  problem 1: 10%, problem 2: 20%, problem 3: 20%
  problem 4: 20%, problem 5: 20%, problem 6: 10%.

- Provide a comprehensive report with relevant tables and figures. Questions must be answered in the order in which they are asked. Page numbers and exam numbers must appear on all pages in the report.
- The front page of the report must be based on the template that is available on Absalon. Fill in the exam numbers of all group members and the total number of pages in the report. The second page of the template must be used to specify which parts of the exam paper is answered by what group member. This page may not contain other information.
- Prepare one STATA do-file that generates all tables and figures that appear in your exam report. Make sure that the do-file can be straightforwardly executed without any errors. Exam numbers must be included in the do-file.
- **The report must not exceed 15 pages**. This includes the main text, tables and graphs in the report, but **not** the front page and the list summarizing the parts of the answer that each group member is responsible for.
- Submit the exam report (including the STATA do-file) electronically. See "Uploading your answer".
- **The exam ends January 4 at 16.00**. The answer must be uploaded to Absalon no later than 16.00.

Access to data:

How to obtain the group data set:

1. Determine the **lowest** number among the exam numbers of the members of the group.
2. Use the **last** digit of this exam number to select the group data set from the data sets posted on the data page.

   > Example: A group of four members with exam numbers 71, 72, 77, and 174 will have "1" as the last digit of their lowest exam number. The group selects the file GROUPDATA1.dta.

3. Download the data to your computer.
4. Open the data in STATA and execute the **describe** command to ensure the data appears operative.

If you have trouble selecting or opening the data, you can contact Rasmus Jørgensen on telephone 3532 3075 during the period 10:00 to 12:00 on January 3.

After this no help will be provided to this or any other parts of the exam.

Uploading your answer:

It is sufficient that one of the group members uploads the exam report.

You submit your answer by uploading the exam report and the do-file to the course webpage on Absalon. In the 'Take-home exam' folder press Upload exam answer. On the next page, press Answer which will bring you to the next page where your answer can be uploaded by pressing Upload file. Remember to finish by pressing the button 'Submit' at the bottom of the page.

Each group must hand in a total of 2 files. The files should be named such that each filename starts with the letter indicated below. The letter should be followed by the exam numbers of all members of the group separated by _ ("underscore").

1. The report must be handed in as a PDF file. The filename must start with the letter R.
2. Submit the group's STATA do-file as a file in plain text format (.txt). The filename should start with P.

Use the same combination of exam numbers for all files.

> Example: A group of four members with exam number 71, 72, 77, and 174
> will submit the following files:
>
> 1. R_71_72_77_174.pdf
> 2. P_71_72_77_174.txt

See more about how you obtain a free PDF converter by following this link:

http://www.pdf995.com/

If you have problems accessing Absalon at the deadline of the exam or if you have difficulties with the upload function you must e-mail your answer to samf-fak@samf.ku.dk.

Handing in your exam answer by e-mail requires that you describe the problems and provide screen dumps that document this.

Introduction to assignment:

"Public Provision of Goods and Services and Unexpected Oil Discoveries in Brazil"

Brazil's production of oil began in the 1940s, when the first on-land oil discoveries were made. Over the next decades, the number of on-land oil fields expanded substantially. In the 1970s, oil was discovered in Brazil's subsoil below the Atlantic Ocean and these offshore oil fields are now the most important oil resources in Brazil. As of 2005, the oil sector in Brazil accounts for roughly 2 percent of the world's oil production and around 2 percent of Brazilian GDP.

In a recent article, Caselli and Michaels (2013) investigate the effects of oil discoveries on local government spending and living standards in Brazil.[1] The authors argue that oil production vary widely across Brazilian municipalities which allow them to investigate the consequences of oil-related revenues for the public provision of goods and services.

Oil in Brazil is inextricably linked to *Petrobras*, the oil multinational controlled by the federal government, which completely dominates the industry. The principal objective of *Petrobras* is to maximize Brazil's oil production. Brazilian law mandates that *Petrobras* pay close to 10 percent of the value of the gross output from its oil fields in the form of royalties. About 30 percent of the total royalties are transferred to municipal governments, while the remaining royalties are received by federal and state agencies. For some municipalities, royalties account for as much as 50 percent of their total tax revenues.

A municipality's royalty income depends on several factors. One key factor is geography. Brazilian law apportions the royalties by first extending each municipality's terrestrial borders onto the continental shelf and then assigns each municipality the fraction of the oil field that lies within these extended borders. Another factor is infrastructure. For example, municipalities with infrastructure for the storage and transportation of oil and gas located on their territory are also entitled to some royalties. Furthermore, some components of the royalty allocation scheme depend on the size of the municipality's population.

The article by Caselli and Michaels investigates what local government does with their revenues – of which some originates from oil production. They analyze components of public spending such as expenditures on education, health, urban development, transportation and social transfers. Moreover, the article examines if Brazil's oil discoveries have trickled down to the population and improved their living standards.

[1] Francesco Caselli and Guy Michaels (2013): "Do Oil Windfalls Improve Living Standards? Evidence from Brazil", *American Economic Journal: Applied Economics*, 5(1), pp. 208-238.

Data documentation

The data set is a cross-section of 3,657 municipalities in Brazil.[2] All nominal variables below are measured in Brazilian 2000-R$. Your exam answers should be based on this specific data set.

Table 1: List of variables

Variable name	Description
Main variables:	
Amc	Brazilian municipality identifier (áreas mínimas comparáveis)
Coast	Dummy variable indicating if the municipality is located on the Atlantic coast or not
Pop	Population in 2000
Mun_exp	Total municipal expenditures per capita in 2000
Mun_rev	Total municipal tax revenues per capita in 2000
Gdpcap	GDP per capita in 2002
Oilgas	Oil and gas output per capita in 2000
Royalties	Royalties from oil per capita in 2000
Mun_exp1991	Total municipal expenditures per capita in 1991
Mun_rev1991	Total municipal revenues per capita in 1991
Gdpcap1970	GDP per capita in 1970
Additional variables:	
Longitude	Longitude
Latitude	Latitude
Dist_fed	Distance to the federal capital (in kilometers)
Dist_state	Distance to the state capital (in kilometers)
State_capital	Dummy indicating if the state capital is located in the municipality or not
School1970	Average years of schooling among people aged 25 and over in 1970
Elec1970	Percent of households with electric lighting in 1970
Sanit1970	Percent of households with toilets linked to main network in 1970
Water1970	Percent of households with water linked to main network in 1970
Mun_exp_educ	Municipal expenditures on education and culture per capita in 2000
Mun_exp_health	Municipal expenditures on health and sanitation per capita in 2000
Mun_exp_urban	Municipal expenditures on housing and urban development per capita in 2000
Mun_exp_trans	Municipal expenditures on transportation per capita in 2000
Mun_exp_welf	Municipal expenditures on social transfers per capita in 2000
Teachers	Teachers per million people in 2005
Clrooms	Classrooms per million people in 2005
Hospitals	Hospitals per million people in 2005
Hincome	Average per capita household income
Poor	Percent of population with a household income below the poverty line

[2] The data set used for this exam is an edited version of the original data used by Caselli and Michaels (2013).

Problem 1:

Use all available observations for this question.

a) Describe the variables listed in table 1 under the heading "Main variables". Provide one or more tables and/or graphs that present relevant characteristics for each variable. Comment briefly.

b) Municipalities situated on the Atlantic coast account for the vast majority of Brazil's production of oil and gas. Provide a table that compares coastal and non-coastal municipalities in terms of relevant characteristics. Include a short discussion of the table.

Problem 2:

Use all available observations for this question.

a) Consider the regression model in (1), where u_m is the error term and Mun_exp_m is municipality m's total expenditures per capita in 2000. Assume for now that the model satisfies MLR.1-MLR.4.

$$Mun\_exp_m = \beta_0 + \beta_1 Mun\_rev_m + \beta_2 Longitude_m + \beta_3 Latitude_m + \beta_4 Coast_m + \beta_5 Dist\_fed_m + \beta_6 Dist\_state_m + \beta_7 State\_capital_m + u_m \quad (1)$$

   i. What is the interpretation of β_1? What is the expected sign of β_1?
   ii. What is the interpretation of β_4?

b) Estimate the model in (1) by OLS. Report your estimates in a table with their standard errors and *t* statistics. Your table should also report heteroskedasticity-robust *t* statistics. Comment briefly.

c) Test the following hypotheses using the OLS estimates from Problem 2.b.
   i. Test the hypothesis that municipalities increase their expected per capita expenditures by one R$ if their per capita tax revenues increase by one R$. Write up the null hypothesis. Specify the alternative that you are testing against and explain why you choose this alternative. What do you conclude?
   ii. Test the hypothesis that geography does not matter for total municipality expenditures per capita. Specify the null hypothesis and the alternative that you are testing against. What do you conclude?

   In each case, explain what test statistic is used and why.

d) Test if model (1) suffers from functional from misspecification. What do you conclude?

e) The data includes information on each municipality's per capita expenditures on education, health, urban development, transportation and social transfers. These categories represent only a fraction of total expenditures. Assume that the following equation holds as a definition:

$$Mun\_exp_m - Mun\_exp\_unspec_m = \sum_i Mun\_exp_m^j \quad (2)$$

where $Mun\_exp\_unspec_m$ denotes unspecified (or unobserved) per capita expenditures in municipality m and j indexes the observed expenditure categories (education, health, urban development, transportation and social transfers).

i. Calculate the unspecified per capita expenditures for each municipality in the data using equation (2).

ii. Consider an alternative version of regression model (1):

$$\begin{aligned} Mun\_exp_m^j = \beta_0^j + \beta_1^j Mun\_rev_m + \beta_2^j Longitude_m + \beta_3^j Latitude_m \\ + \beta_4^j Coast_m + \beta_5^j Dist\_fed_m + \beta_6^j Dist\_state_m \\ + \beta_7^j State\_capital_m + u_m^j \end{aligned}$$

where j denotes the observed expenditure categories, including unspecified expenditures.

Show that the category-specific β_1^j parameters sum to the β_1 parameter in model 1. Explain why this relationship exists between model (1) and the alternative models with category-specific expenditures as the dependent variable. Your answer should be based on a theoretical argument regarding the population regression model.

iii. Estimate the alternative models from Problem 2.ii by OLS. Comment on your findings and confirm the theoretical prediction regarding the category-specific parameters from Problem 2.ii.

Problem 3:

Caselli and Michaels argue that municipality revenues are likely to be an endogenous regressor, as municipalities may misreport their revenues to attract more federal transfers. Because of this concern, they suggest using an instrumental variable strategy to estimate the effect of government revenues on spending. Specifically, they consider the following two variables as potential instruments:

1. Oil and gas output per capita in 2000 (*oilgas*)
2. Royalties from oil per capita in 2000 (*royalties*)

Use all available observations on coastal municipalities for this question. You may disregard any heteroskedasticity of the error term in your answer.

a) Discuss the conditions that must be satisfied for *oilgas* and *royalties* to be relevant and valid instruments for Mun_rev in model (1). Are the conditions likely to be satisfied for both variables or only one of them? Present empirical evidence as needed to support your answer.

b) Estimate model (1) by two-stage least squares (2SLS) using your preferred instrument variable(s) from Problem 3.a. Report your results in a table and compare them with your OLS results from Problem 2. Comment briefly.

c) Test if Mun_rev is in fact endogenous or not in model (1). Describe how you can test this, report your results and conclude.

Problem 4:

Use all available observations for this question. You may disregard any heteroskedasticity of the error term in your answer.

The data from Brazil has information on per capita municipal expenditures and revenues for the years of 1991 and 2000.

a) Write up a two-period panel data model on the basis of model (1).

b) Derive the first-differenced (FD) equation for your model from Problem 4.a.

c) Estimate the first-differenced (FD) equation from Problem 4.b by OLS using all available observations. Next, estimate the FD equation for coastal and non-coastal municipalities. Discuss if the FD estimator is consistent. Comment on your results.

Problem 5:

Use all available observations on coastal municipalities for this question. You may disregard any heteroskedasticity of the error term in your answer.

Corruption is widespread in Brazil and reported expenditures may not reflect how municipality funds are actually being spent. For that reason, you are asked to carry out an investigation of the effects of municipality revenues on real outcomes such as the number of teachers, classrooms, hospitals, household income and the municipal poverty rate.

Are increases in tax revenues due to oil discoveries associated with a better public provision of goods and services?

Problem 6:

Write a brief summary of the main results of your analysis. Include a table that summarizes the main results and comment on the table.

What are your overall conclusions regarding the relationship public spending, oil discoveries and living standards in Brazil?