

## Mandatory Assignment 3: Exam in Econometrics I from May 2017

Mandatory assignment 3 is the third of three mandatory assignments in Econometrics I. Three assignments must be passed in order to go to the final exam. To pass a mandatory assignment, it is required that:

- An adequate response is given to all questions in the assignment.
- More than half of the questions are answered correctly.
- Answers are written in a precise and easy to understand language.

The assignment may be answered in groups of max 3 students.

Mandatory assignment 3 is identical to the take-home exam in Econometrics I from 2017. There are instructions on the following pages that are specific to the final exam, but will **not** apply to mandatory assignment 3. For the purpose of answering this assignment, please note that:

1. All relevant materials are available on Absalon.
2. The final report and STATA do-file must be uploaded to your class folder on Absalon.
3. The numerical part of your study ID must be used as your exam number.
4. The assignment is due **Thursday 30 April at 23:59**.

Written Exam for the B.Sc. or M.Sc. in Economics Summer 2017

## Økonometri I/Econometrics I

Take-home exam

May 31, 2017

This exam consists of 8 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. That is, 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 at limited period or permanent expulsion

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

## Practical instructions for the take-home exam

Read entire exam before you respond. Answer every question in each problem. The exam consists of five problems in total.

The exam can be answered in groups of a **maximum of three students**. Hand-in a single report for the entire group in which each group member's contribution to the report is specified.

You must submit a comprehensive report with relevant tables and figures. The front page of the report must use the template available at <https://eksamen.ku.dk/>. Fill in the exam numbers of all group members in ascending order on the front page. The second page of the template must specify which paragraphs and/or sections of the report are answered by which group member. This page may not contain other information.

Prepare one STATA do-file generating all tables and figures that appear in your report. The program must produce tables and figures in the same order as they appear in the report. Comments should clearly indicate which table or figure appearing in the report is being produced. Make sure that the do-file can be executed without any errors. The do-file must include the exam numbers of all group members.

**The report must not exceed 8 (normal) pages.** This includes the main text, tables and figures in the report, but not the front page and the list summarizing each group member's contribution to the report.

For the exam in Econometrics I, a normal page is defined as a text document with the following attributes<sup>1</sup>:

- A4 format
- Font size set to 12
- Line spacing set to 1.5
- Margins (left/right/top/bottom) of at least 2.5 cm

The exam ends **May 31 at 22.00 (10:00pm)**. The report and the STATA do-file must be uploaded electronically no later than 22.00.

## Uploading your report

Each group must hand-in only one report in total.

One student hands in the report by uploading it to University of Copenhagen's Digital Exam system and then adding the rest of the group members to the hand-in. Go to the website <https://eksamen.ku.dk/> and click on 'Log in as student'. Use your regular KU login and password to enter Digital Exam. Click on 'Econometrics I' in your assignments. On the page 'Information about the hand-in', you must add all other group members to the handed-in answer (if you are in a group). Click on 'Add member' and follow the instructions on Digital Exam to invite your fellow group members. Group members will be added to the handed-in answer as soon as they **accept** your invitation.

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<sup>1</sup>The Study Handbook for the Economics program defines a normal page as 2,400 characters, but for this exam, a normal page is instead defined in terms of format, font size, line spacing and margins.

Next, go to 'Upload hand-in' to upload your files. Each group must upload two files:

1. The report itself must be uploaded as a PDF file. The filename must start with the letter R followed by the exam numbers of all members of the group in ascending order and separated by \_ ("underscore").
2. The STATA do-file must be uploaded as a file in plain text format (.txt). The filename must start with the letter P followed by the exam numbers of all members of the group in ascending order and separated by \_ ("underscore").

Use the same combination of exam numbers for both files.

*Example:* A group of three members with exam numbers 72, 82 and 174 will submit the following files:

1. R\_72\_82\_174.pdf
2. P\_72\_82\_174.txt

If needed, a free PDF converter is available at [www.pdf995.com](http://www.pdf995.com).

If you have problems accessing the Digital Exam system 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](mailto:samf-fak@samf.ku.dk) by 22.30 (10:30pm). Handing in your exam answer by e-mail requires that you describe the problems and provide screen dumps documenting this.

## Access to data

For the take-home exam, there are several data sets available on the Digital Exam website (<https://eksamen.ku.dk/>). Follow the instructions below to pick the correct data set for your group:

1. Determine the **lowest** number among the exam numbers of the group members. Use the **last** digit of the **lowest** exam number as your "group number".

*Example:* A group of three members with exam numbers 72, 82 and 174 will have "2" as the last digit of the lowest exam number.

2. Download the STATA file groupdataX.dta from the Digital Exam website, where X is equal to the group number.

*Example:* The group from before downloads groupdata2.dta from the Digital Exam website.

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 may contact Rasmus Jørgensen on telephone 3532 3075 during the period 10:00am to noon on May 31.

After this, no additional help will be provided for the exam.

Introduction to the assignment:

## ”US Jobs and Import Competition from China”

A main theme of the recent US presidential election is the issue of globalization and its effects on American workers. During the election campaign, candidate Trump often blamed China for the loss of manufacturing jobs in the US, and now, part of his ”Make America Great Again” plan is to bring back domestic jobs by re-negotiating existing international trade agreements.

Economists have long recognized a link between domestic jobs and international trade. One basic observation of the US economy is that the fraction of workers employed in the manufacturing sector fell by a third between 1990 and 2007. In the same period, US imports from low-wage countries increased from 9 to 28 percent of total imports, with China accounting for 89 percent of this growth. Much of this change has been attributed to the economic miracle of China which is largely due to its transition to a market-oriented economy as well as China’s accession to the World Trade Organization (WTO) in 2001. One would expect that lower trade barriers between the US and China cause some US jobs to move to China where they can be performed at lower costs. With production increasingly taking place in China, final goods are then imported to the US for final consumption instead of being produced locally. This is known as import competition.

Autor, Dorn and Hanson (2014) present an analysis of the effect of rising Chinese import competition on US manufacturing jobs.<sup>2</sup> Their analysis is based on data on a larger number of geographical areas in the US that differ in the relative importance of different manufacturing industries for local employment – and their exposure to import competition from China.

A key challenge when estimating the employment effects of import competition is the issue of confounding factors. For instance, the substitution of US workers for Chinese workers in manufacturing production suggests that import competition and employment are negatively related. On the other hand, unobserved local demand shocks may increase overall labor demand for both US and Chinese workers, leading to a positive relationship between import competition and employment. To isolate the impact of Chinese import competition, Autor, Dorn and Hanson argue that the global rise in imports from China reflects an exogenous change in China’s global competitiveness that is common to all countries in the world. Moreover, exogenous changes in China’s supply conditions have had a different impact on different geographical areas in the US, depending on the initial patterns of industry specialization across regions in the US.

In this exam, you are asked to estimate the causal effect of Chinese import competition on US manufacturing jobs.

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<sup>2</sup>This exam is inspired by David Autor, David Dorn and Gordon Hanson, “The China Syndrome: Local Labor Market Effects of Import Competition in the United States”, *American Economic Review*, 2014, pp. 2121-2168. The data used in this exam are simulated, and it is not possible to replicate the results in the paper using the data provided here.

## Documentation of the data

The data consists of 1,324 observations on 662 commuting zones in the US for two time periods, 1990-2000 and 2000-2007. Commuting zones are defined as geographical areas with strong economic relationships within a given region of the US. As such, each commuting zone may be thought of as geographical subeconomy of the aggregate US economy. The following variables are available for analysis:

**Table 1: List of variables**

STATA name	Text label	Description
czone	$c$	Commuting zone identifier.
t2	$t2$	Time dummy, indicating if an observation belongs to the second period (2000-2007) or not.
dsL	$\Delta sL_{ct}^{man}$	Percentage change in the manufacturing employment share in commuting zone $c$ in period $t$ .
dIPWusch	$\Delta IPW_{ct}^{USCH}$	Percentage change in US imports from China per worker in commuting zone $c$ in period $t$ .
dIPWusmx	$\Delta IPW_{ct}^{USMX}$	Percentage change in US imports from Mexico per worker in commuting zone $c$ in period $t$ .
college	$college_{ct}$	Percentage of college-educated population in commuting zone $c$ in the first year of period $t$ .
foreignborn	$foreignborn_{ct}$	Percentage of foreign-born population in commuting zone $c$ in the first year of period $t$ .
routine	$routine_{ct}$	Percentage of employment in routine-intensive jobs in commuting zone $c$ in the first year of period $t$ .
dIPWotch	$\Delta IPW_{ct}^{OTCH}$	Percentage change in other countries imports from China per worker in commuting zone $c$ in period $t$ .
dIPWukch	$\Delta IPW_{ct}^{UKCH}$	Percentage change in UK imports from China per worker in commuting zone $c$ in period $t$ .
dIPWotmx	$\Delta IPW_{ct}^{OTMX}$	Percentage change in other countries imports from Mexico per worker in commuting zone $c$ in period $t$ .

*Note 1:* All variables expressed in percentage changes represent annual average changes within the two periods. In this way, percentage changes across the two time periods can be compared even though the periods are of different lengths.

*Note 2:* Other countries include Australia, Finland, Germany, Japan and the UK.

*Note 3:* The variables  $\Delta IPW_{ct}^{OTCH}$ ,  $\Delta IPW_{ct}^{UKCH}$  and  $\Delta IPW_{ct}^{OTMX}$  are defined in similar ways. To clarify how they are constructed, let's take a look at  $\Delta IPW_{ct}^{UKCH}$ . Suppose San Francisco is a commuting zone in the data. At the beginning of a period  $t$ , San Francisco has employment in various industries (say, agriculture, IT and many others). Imagine this employment for each industry is expressed relative to the US aggregate employment in every industry (say, San Francisco employs 10 percent of all IT workers in the US, but only 0.01 percent of all agricultural workers).  $\Delta IPW_{ct}^{UKCH}$  is calculated by multiplying these initial employment shares with the changes in UK imports per worker for each industry and then summing up across industries. One way to think about this is: Imagine San Francisco is a commuting zone in the UK instead of the US, but with the same employment characteristics. What is the hypothetical change in San Francisco imports from China in this scenario?  $\Delta IPW_{ct}^{UKCH}$  for  $c = \text{San Francisco}$ !

## Problem 1 (20%)

1. Provide a descriptive analysis of the variables in your data using relevant summary statistics. Describe how US imports have changed across commuting zones between 1990 and 2007.
2. Consider the regression model:

$$\Delta sL_{ct}^{man} = \beta_0 + \delta_0 t_{2t} + \beta_1 \Delta IPW_{ct}^{USCH} + \delta X_{ct} + u_{ct} \quad (1)$$

where  $X_{ct}$  includes  $college_{ct}$ ,  $foreignborn_{ct}$  and  $routine_{ct}$ .

- (a) What is the interpretation of  $\beta_1$ ?
- (b) What is the expected sign of  $\beta_1$ ?
- (c) Estimate the parameters of model (1) using OLS. Report your estimates in a table with relevant standard errors. Is the OLS estimate of  $\beta_1$  consistent with your expectation?

## Problem 2 (20%)

Unobserved local demand shocks may affect the estimated relationship between the employment share of US manufacturing and import competition from China. Autor, Dorn and Hanson (2014) argue that rising Chinese import competition reflects mostly changes in the supply conditions of producers in China. They argue that changes in China's production supply in recent decades have led to rising imports from China to the US as well as to many other countries in the world. As such, the authors view the global increase in Chinese import competition as a result of exogenous changes in China's global competitiveness.

1. Discuss the conditions needed for  $\Delta IPW_{ct}^{OTCH}$  to be a relevant and valid instrument for  $\Delta IPW_{ct}^{USCH}$  in model (1). Are the conditions likely to be satisfied in this case? Present empirical evidence as needed to support your answer.
2. Estimate the parameters of model (1) using IV. Report your results in a table and discuss how they compare to your OLS results from Problem 1.
3.  $\Delta IPW_{ct}^{OTCH}$  is based on the imports from China to a group of other countries. The UK is part of this group of other countries, but a separate measure of UK imports from China is available. Use  $\Delta IPW_{ct}^{UKCH}$  as an additional IV and implement a test of overidentifying restrictions.
4. US manufacturing jobs may also relocate to Mexico due to lower Mexican production costs. Extend model (1) with  $\Delta IPW_{ct}^{USMX}$  and estimate the parameters by IV. Is the impact of Mexican and Chinese import competition on US manufacturing different?

### Problem 3 (20%)

US imports from China have increased dramatically in recent decades. Some commentators argue that the impact of Chinese import competition itself has changed as well. To address this issue, consider an extended version of model (1):

$$\Delta sL_{ct}^{man} = \beta_0 + \delta_0 t2_t + \beta_1 \Delta IPW_{ct}^{USCH} + \beta_2 (t2_t \times \Delta IPW_{ct}^{USCH}) + \delta X_{ct} + u_{ct} \quad (2)$$

1. Estimate the parameters of model (2) using 2SLS with  $\Delta IPW_{ct}^{OTCH}$  and  $(t2_t \times \Delta IPW_{ct}^{OTCH})$  as IVs. Implement the 2SLS estimator manually. Report the first and second stage results in a table and comment on your results.
2. Estimate the parameters of model (2) using IV and test for no difference in the impact of import competition across the two time periods.
3. Conduct a test for exogeneity of  $\Delta IPW^{USCH}$  and  $t2 \times \Delta IPW^{USCH}$ .

### Problem 4 (20%)

Measurement error in an explanatory variable may lead to attenuation bias in the OLS estimator. This problem may be corrected for using a relevant and valid instrument. That said, one concern is that the instrument itself is measured with error which may create an additional source of bias. To address this issue consider a simple regression model:

$$y_i = \beta_0 + \beta_1 x_i^* + u_i \quad (3)$$

where  $x_i^*$  is the true but unobserved explanatory variable. The observed explanatory variable,  $x_i$ , is defined as  $x_i = x_i^* + \epsilon_i$ , where  $\epsilon_i$  is a measurement error that is uncorrelated with the true explanatory variable, i.e.,  $cov(x^*, \epsilon) = 0$ . An instrument,  $z$ , is available, but it is measured with error. Assume  $z_i = z_i^* + \eta_i$ , where  $z_i^*$  is the true but unobserved instrument and  $\eta$  is a measurement error. The true instrument is related to the true explanatory variable,  $cov(z^*, x^*) = \theta \sigma_{x^*}^2$ , where  $\theta$  is a parameter and  $\sigma_{x^*}^2$  is the variance of  $x^*$ . The measurement errors in the two variables may be correlated,  $cov(\epsilon, \eta) = \rho \sigma_\epsilon^2$ , where  $\rho$  is a parameter and  $\sigma_\epsilon^2$  is the variance of  $\epsilon$ . To simplify the analysis below, assume that  $u$  is independent of  $z$  as well as  $cov(z^*, \epsilon) = cov(x^*, \eta) = 0$ .

1. Derive the probability limit of the IV estimator of  $\beta_1$  under these assumptions. For what values of  $\rho$  is the IV estimator a consistent estimator of  $\beta_1$ ?
2. For what values of  $\theta$  and  $\rho$  are the probability limits of the OLS and IV estimators the same, i.e.,  $plim \hat{\beta}_1^{OLS} = plim \hat{\beta}_1^{IV}$ ?

### Problem 5 (20%)

Consider the following data generating process (DGP):

$$y_i = \beta_0 + \beta_1 x_i^* + u_i \quad (4)$$

$$x_i = x_i^* + \epsilon_i \quad (5)$$

$$z_i = \theta x_i^* + \eta_i \quad (6)$$

$$\eta_i = \rho \epsilon_i + \mu_i \quad (7)$$

$$\beta_0 = 4, \beta_1 = 3, \theta = 1 \quad (8)$$

$$x^* \sim N(1, 4), u \sim N(0, 1), \epsilon \sim N(0, 1), \mu \sim N(0, 1) \quad (9)$$

Implement a simulation experiment of  $\widehat{\beta}_1^{OLS}$  and  $\widehat{\beta}_1^{IV}$  based on the above DGP, where  $y$  is the dependent variable,  $x$  is the observed explanatory variable, and  $z$  is the observed instrument. Consider the following values of  $\rho$ : -0.5, 0, 0.5 and 1. Pick a seed number of your choice and write it explicitly in the main text of your report. Draw samples of 1,000 observations and replicate the experiment 500 times. Report summary statistics and histograms to document the results from the simulation experiment. Are the simulation results in line with the analytical statements from Problem 4? Discuss and compare your results. Does the IV estimator suffer from attenuation bias in the presence of measurement errors?