EC2B1 PROJECT 2024/25

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5. A bit of background on group formation process.
6. Project submission form (to be provided later).

1. PROJECT TASKS.

The main questions: Your group will be randomly assigned one country. It is your job to characterize long-run economic developments in that country focusing on how capital accumulation, saving, population growth and R&D has affected this long-run development. That is, you should abstract from institutional and cultural issues which may very well have been important as well.

What to submit? You have to submit (*i*) the essay and (*ii*) the code. The essay should contain all the information we ask for including tables and figures. That is, the marker will check the code, but should not have to look at the file containing the code to see what the figures and tables look like.

Coding part of the project

To answer the questions below, you are recommended to use the data that will be provided.

A. **Trend calculation.** Calculate a trend time paths for (the natural logs of) (i) real GDP and (ii) real GDP per capita. All at constant 2017 national prices using data over the whole sample. We will provide a simple template Python program that you can use to fit a time trend. Present two panels with the natural logarithm of each variable and the corresponding trend time path.

   - As a robustness exercise, use the levels instead of log levels in the trend regression.

B. **Extract TFP measure.** Take a stand on the production function and extract a measure for TFP. You can do this using (i) real GDP (rgdpna), (ii) the number of employed workers (emp), and (iii) the capital stock at constant 2017 national prices

(rnna). But you may also consider using the human capital index (hc). The benchmark value for alpha should be 0.3 but check whether your results are robust to alternative values.

C. **Growth accounting.** Calculate the contribution of each input variable to measured changes in GDP. Remember that we are interested in long-run developments. It is up to you to think on how to best capture that and the answer may very well be different for different countries. Tip: Check HW #2 and recall that it is wrong to do growth accounting per year and then take the average.

D. **Labour productivity.** Construct a series for labour productivity, i.e., GDP per worker.

Description part of the project

1. **Document and discuss empirical observations.** Discuss your findings of parts A, B, and C.
    a. What do the fitted trends look like? Do they look reasonable? The point is not to use (fancy) econometric tests. But ask yourself whether the fitted lines looks like something describing long-term economic developments. Long-run does not necessarily mean the average over the whole sample. Would it make sense to split the sample in sub periods for your particular country? If so, which ones and why?
    b. As part of exercise C above, you had to decide on how to do growth accounting and in particular which subperiods to use. Are there changes over time in terms of what factors drives changes in GDP? This part should be descriptive in nature. Before getting to explaining something, one always first has to clearly document all empirical findings.
    c. The next step is to shed some light on the long-term movements of GDP and per capita GDP.
        i. That is, why were there changes in these two variables? Growth accounting is the first step as it identifies how important TFP growth, capital accumulation, and population growth have been.
        ii. But feel free to dig a bit deeper and see whether you find explanations for the long-run growth factors of these series. Here it would be helpful to obtain a bit more information about your country. This could be descriptive information or behaviour of other data in the Excel file. **We don't expect a detailed investigation.** Just try to come up with a few relevant observations. Be

careful not to start explaining short-term movements. This project is about long-term developments, not about changes related to business cycles.

2. **Solow Model.** Is the Solow model capable of explaining part of the growth developments in your allocated country?
3. **TFP versus labour productivity.** TFP and labour productivity are two different ways to measure productivity.
    a. First, discuss whether there is necessarily a positive relationship between the two *in theory*.
    b. Next, document how these two series relate to each other in your country. Here you should just give a description of the two series. What is the best way to inform the reader of key aspects of these two series? Again, don't focus on short-term movements.
    c. Discuss reasons for the long-term patterns observed which could either be that they move together or diverge.
4. **Romer model.** Is the Romer model useful to explain part of the growth patterns in your country? This does not have to be the Romer model with constant parameters. Also, it is perfectly fine to be critical of the Romer model if your country does not provide support.
5. **Choose an informative title.** Choose a good title! Thus, not something like "Growth Developments in Country X." Use your most important findings/arguments to form a good title.
6. **Bullet points.** It is fine if you use concise bullet points to answer parts of questions. For example, when discussing the relevance of the Romer model you could have a list of observations in favour and a list of observations that are not.
7. **Abstract.** Include an abstract of at most 100 words. This does not count towards the word limit.

Link between project and course material.

The course project closely follows what we covered in AT lectures, the textbook, and the assignments. Specifically,

1. **Part A, long-run trends.** This is how we started the course in lecture 1 and the accompanying required readings. You are asked to document long-term growth for your country. The slides and required readings should help in terms of putting your quantitative results in perspective.

2. **Part B, production function.** This has been a common feature throughout the course.

3. **Calculate the contributions of the different components using growth accounting.** This was given a lot of attention in the lectures, the readings, and the assignments. For example, the slides discuss in detail the case for Hong Kong and Singapore, so in this course project you are asked to now do it for your country.

    a. Note that you were asked to do a growth accounting exercise in assignment 2. It was pointed out you could do this with Python or Excel. For the course project, you have to do it with Python.

4. **Explanation part.** This is the most important part of the project. Again, it follows closely the AT course material.

    a. One of the components is capital and this is where the Solow growth model comes in. And we have discussed as examples, Hong Kong and Singapore (but also recall Germany and Japan after WWII).

    b. Another one is employment and/or population. Growth in the number of people in the economy is a key variable in the Solow model.

    c. An important part of your project should be devoted to TFP. That is, the key focus of the Romer model. The Romer model focuses on TFP increases generated by research and development. Feel free to talk about productivity more generally. For example, you may discuss whether inputs are allocated efficiently (which would also affect productivity as was the case during the development phase of Singapore). Also, you many want to discuss whether the institutional aspects discussed in lectures 7 and 8 are relevant.

2. IMPORTANT COMMENTS ABOUT MARKING AND WHAT IS EXPECTED.

1. **Key is doing the work.** The most important factor in the marking of this project is whether it is clear that you put in a serious sensible effort dealing with the exercises described in this document. Although you cannot skip an exercise, we understand that you may put a bit more effort in one and less in another. That is, you can use your own preference to shape your essay. Our hope and expectation are that most groups will indeed put in serious effort and manage to do so. If true then marks are expected to be between 70 and 80.[1]

[1] Not doing all the tasks will mean a lower mark than 70 and brilliance could lead to marks higher than 80.

2. **Minimal Python and what matters.** Although this project has a Python component it is a minimal one and would require only a very small investment in learning Python. Given the massive increase in the use of data science, it could harm your career and/or future study if you don't know a minimum of programming. But other than checking whether you actually wrote the programs, **your project mark will NOT depend on how sophisticated your programs are.** Of course, some of you may want to learn more advanced programming and we encourage you to do so. But we understand that there are time constraints. And you will not get a higher mark if you, for example, make fancier graphs. The very short video made by Wouter and the Python programs provides as part of the homework answer keys are more than sufficient for this project. Each group is expected to do the programming themselves and suspicious similarities between programmes will be investigated. Note that the LSE considers sharing your programmes with others to be academic dishonesty of your group.

3. **Working in groups** comes with challenges. That is also a useful skill to learn. And those challenges may not be the same for everybody. For example, there may be some students who shirk and get "away with this shirking" *if* their group members don't use the option on the submission form to request some shifting of the available marks across group members (more on this below). It is also possible that some groups benefit because they have (better) computers at home whereas other may have to come to campus. It does *not* make sense, however, to argue that differences in pre-existing Python skills are creating inequality issues given the small programming component, the minimum time requirement needed to learn Python, the usefulness for each and every LSE student to learn a minimum of Python, how Python matters for the marking (see previous point), and the resources we make available to help you with programming. However, you may face group related challenges. For example, communication/meetings may be tricky because of personal circumstances. Or, to say it bluntly there may be uncooperative members. Ideally you will let us know as soon as possible so we can interfere. But, on the submission document you will also be given a chance to describe these (and in addition to the group statement individual statements are possible). And, we will take any challenges you faced during group formation or later on into account when marking. Keeping good records is therefore important.

3. TIPS.

Good reasoning and documentation are essential!

- It is important that you document your answer. So don't just say *"we think the TFP measure went up because capital was allocated to more productive sectors."* Instead, provide some evidence of sectoral shifts and explain why this could have improved productivity in your country of study.

- You should use economic arguments. Feel free to use simple mathematical models as in class, but if you do then keep them as parsimonious as possible and always provide extensive intuition.

- It is **MUCH** better to focus on a few determinants of TFP and discuss these in detail than to come up with long lists. We are mainly looking for solid, creative, economic reasoning. Not a complete answer, which is impossible given the word limit.

- Feel free to use any material you want, from specialist textbooks to articles from the popular press. But all sources must be properly referenced.[2] Make sure to include a complete bibliography.

- You may use AI tools for the debugging of your Python code. But note that we will check whether the required programming comments you provide are consistent with the code. In the end, you and not AI will be responsible for the submitted work. And you may be asked to explain your own code.

- In your code file, be sure to leave a lot of comments explaining what particular lines of code are doing. Here is an example of a good comment and a bad comment for a particular line of code:

  Good comment:

```
# Setting the initial value for the output time series. The
initial values for capital and TFP were given to us in the
assignment.
y_path[0] = f(k_path[0], A_path[0])
```

  Worse comment:

```
# Defining y_path.
y_path[0] = f(k_path[0], A_path[0])
```

What you have to submit.

- Essay of at most 3,000 words.
- Computer programs. The code should contain a clear verbal description what each part of the code does. Lines of code that are not clearly self-explanatory need to be commented.

[2] And using quotes from other sources without proper citations is plagiarism and a form of academic dishonesty.

- A bibliography.
- Submission form.

4. Administrative issues

1. **Group formation**. Groups have a minimum of three and a maximum of five members.

2. **Admin lead.** Each group has to choose an "admin" lead.

    a. The admin lead student is responsible for submission.

    b. Each group is associated with the class teacher of the admin lead. This mainly means that the class teacher of the admin lead is the main one that is responsible for guidance. It is fine to have students from different classes.

    c. There may be some reassignment to other class teachers if the load across class teachers turns out to be unbalanced.

3. **Important for group formation.**

    a. When you have formed your group then let us know by navigating to the course Moodle page, clicking on the "Python Coursework" box, and then pressing the "Group formation link" button. You will then be taken to a Google Form with which you can submit your group's details. To fill out the form you will need every group member's name (as it appears in the School's registers) as well as their ID number.

    b. If you are unable to form a group or if you are able to only form a group of two, then please still submit your information via the "Group formation link" described above. We will then assign you to a group.

    c. **Deadline for group formation:** The deadline for the first round of group formation is *November 29th*. If you have not formed a group by that date, then we will help you with the allocation.

4. **Allocation of individual marks**: Each project will be given a group mark. As pointed out above, we will take into account other issues than the submission itself. For example, if, it was difficult to meet frequently with all group members or if the group turned out to be a very bad match (and you can describe this). If *X* is the group mark and *n* the number of students in the group, then *Xn* points will be allocated among the *n* students.

    a. If all students agree that points should be divided equally, then each student gets X.

b. If all students agree that there should be some reallocation, then a proposal can be made on the submission form. For example, the group can ask that Johnny get an extra three points and Keyu, Satyajit, as well as Kevin get one point less.

c. However, if there is disagreement on allocation among individual members, then this can be indicated at the submission stage and individual statements can be submitted. If there are indeed substantial differences in contributions, then we will make adjustments meaning that some will get more than *X* and some will get less than *X* (but the average mark remains equal to *X*.)

d. If a group member stops contributing, then you must let the class teacher of the admin lead know as quickly as possible.

e. To prevent conflicts later on, keep a diary of what you have agreed on and on tasks completed by different group members.

5. **Submission deadline of Final Project: Thursday February 20th 2025 noon.**

5. Background on group formation issues.

- We have decided to let choose students form their own groups. There are always some students who are strongly in favour of doing this and some students who are strongly against it.
    - The students who argued in favour of randomization before the details of the project were revealed last year were actually not so upset later on.
    - In fact, everything went very smoothly whereas in some other course were randomization was used there were several conflicts.
- A couple things that you should take into account.
    - Your mark will mainly depend on whether you actually do the work.
    - Some students think there is an advantage of being in a group with programming nerds. However, the Python component is small and programming sophistication does not give you a higher mark. In fact, there is big advantage of learning/doing (more) Python yourself given the massive increase in the need for employees to know data science techniques.

- An argument often given in favour of randomization is the following. Shengxing and Lisa are equally smart but Shengxing has many smart friends and so will get a higher mark.
    - As point out above, that isn't as true here since most of your mark will be related to actually doing the work.
    - Of course, even with randomization the ability of Shengxing's and Lisa's group members may be very unequal and so randomization doesn't equalize ability of other group members.
    - Most importantly, past practice has shown that randomization at times leads to some nasty circumstances that are clearly not fair because the group members just don't get along. Suppose that Lisa—for no fault of her own—doesn't get along with her group members and is a bit excluded. If these other group members are shrewd, keep good records, and can document that Lisa contributed less then Lisa might get a lower mark (as pointed out above group input can result in unequal marks). Last year, we didn't have any of such problems whereas have occurred when randomization was used.
- Another problem that we noticed when randomization was used was true freeriding (the idea from the last bullet point was that Lisa was willing to work but that the "evidence" of their shrewd group members made it seem that Lisa was freeriding.)