# Exercise chapter 7

The figure shows the log of GDP and the investment share in GDP for four countries – Ghana, Argentina, South Korea and Australia – over the period from the 1950s to 2000 taken from the PENN World Tables. The data is available in ‘Macro\_PEBLIF’. Answer the questions below.

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| **Figure 7.3: GDP and investment for four countries: 1950-2000** | |
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1. Rank the countries by their level of GDP in 1955 and 2000.

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| list country rgdpch if year==1955 | list country rgdpch growth\_55\_00 if year==2000 |
| +------------------------+  | country rgdpch |  |------------------------|  4. | AUSTRALIA 9899.42 |  5. | ARGENTINA 6860.421 |  6. | KOREA, REP. 1458.673 |  8. | GHANA 921.3561 |  +------------------------+ | +------------------------------------+  | country rgdpch growth~00 |  |------------------------------------|  | AUSTRALIA 25559.02 2.1078088 |  | KOREA, REP. 15875.84 5.3050472 |  | ARGENTINA 11006.46 1.0504737 |  | GHANA 1350.802 .85023865 |  +------------------------------------+ |

In 1955 Ghana and South Korea had roughly the same level of income. Argentina was about 30 per cent poorer than Australia and both Australia and Argentina much richer than either South Korea or Ghana. By 2000 this ranking had changed so that South Korea was now nearly 15 times richer than Ghana. Argentina’s income had increased substantially (by 60%) but was now less than half that of Australia.

2. How would the Solow model explain the change in ranking that you observe?

You need to be clear on which Solow model you have in mind. If we take the simplest in which we have only physical and not human capital then the two variables that determine the steady state level of income are the savings ratio and the population growth rate. Recall that in the long run the rate of growth of the economy in the Solow model is given by the exogenous rate of technical progress which, again in the simplest model, is a common rate across countries.

If we take this last assumption seriously and assume it is about 2 per cent per annum (you will see this is the average of the pooled regression of these four countries) then our task is to explain why South Korea grew at more than twice this rate and both Argentina and Ghana at less than half this rate.

The charts you are given in the question supply one possible answer. The rate of investment to GDP has trended up for South Korea and trended down for Ghana. The Solow model implies that Ghana will move to a lower steady state level of income and South Korea to a higher one as a result of these changes in investment behavior in the economy. Note that there appears to be no trend in the investment to GDP ratio for Argentina and Australia.

What of the other variable in the Solow Model namely the rate of population growth? The table below charts this growth rate over the period for the four countries. The chart is for the raw data and it deliberately has not corrected errors in the underlying data, for example the population growth rates in the early 1950s in South Korea, which you need to do before using the data.

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In all four countries there is evidence of a downward trend in the population growth rate, although it is less clear for Ghana than the other countries. However by the end of the period the population growth rate was lowest in South Korea at under 1 per cent per annum and highest in Ghana at 2.3 per cent per annum. While population growth rates at about 1.2 for Argentina and Australia are higher than for South Korea they are half the rate for Ghana. (See Stata file ‘Exercise\_Chapter\_7.do’for the data)

It is clear that in using the Solow model to explain the change in ranking for South Korea and Argentina by far the most important factor is the rise in the investment rate for South Korea relative to Argentina. In seeking to explain Ghana’s poor performance, an average growth rate of only 0.8 per cent per annum over the period, the fall in the population growth rate would have moved its steady state income in the right direction but by far less than that for the other countries. So its relative ranking would have been affected by the relatively slow rate of decline of the population growth rate. The decline in its investment rate would, in the context of the Solow model, be the most important factor explaining its poor growth rate.

3. Test for the order of integration for both the GDP and investment data for all four countries and report your results.

This is done in the Stata do file. It is the essential preliminary to answering the next two question. For GDP this was carried out in ‘Exercise\_Chapter\_6\_Part\_B’. For the investment share you can find the results in ‘Exercise\_Chapter\_7.do’

4. Test if the log of GDP and the investment share are cointegrated in each of the countries.

See ‘Exercise\_Chapter\_7.do’

5. Test if the growth rate of GDP as measured by the first difference of the log of GDP is cointegrated with the investment share for each of the countries.

See ‘Exercise\_Chapter\_7.do’

6. Do your answers to questions 4 and 5 provide insights into why the change in ranking observed in your answer to question 1 has occurred?

You will see that in all four countries there is some evidence that the log of GDP and the investment share are not co-integrated which the growth of GDP and the investment share are co-integrated. In question 2 above you were asked how the Solow model would explain the change in rankings. The explanation there may have seemed quite plausible but in formally testing the model on time series data the properties of that data are crucial. The Solow model predicts that while the investment rate affects the long run level of income it does not determine the long run growth rate. In contrast models of endogenous growth (see the next chapter and exercise) allow this long run growth rate to be endogenously determined within the model and one such formulation would be to allow investment to directly affect.

While this time series evidence is consistent with an endogenous formulation it is simply suggestive and in no way conclusive. To proceed further it would be necessary to extend the time series analysis beyond the two variable case we have been considering as the Solow model also depends on the population growth rate.