Department of Economics

Queen's University

ECON239: Development Economics

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Assignment #1

Due Date: 2.30pm, Thursday October 8, 2009

Section A (40 percent)**:** Briefly discuss the validity of each of the following statements. In your answer define or explain as precisely as possible any terms or concepts which are underlined, with particular reference to the context in which they are being used. The text for each answer should be no longer than a page, but you also should also include diagrams or examples where appropriate. All questions have equal value.

A1. In 1990, the country of Xanadu is characterized by almost zero trade with the rest of the world, so that most of its GNP consists of non–traded goods, and there is significant unemployment. Suppose that by 2000, Xanadu has started to produce a large quantity of manufactured goods (using its unemployed labour) that it exports to the US in return for US$. Assuming that the production of non– traded goods remains unchanged, the rise in Xanadu's GNP measured in US$ using <u>official exchange rates</u> will be under–estimated relative to that measured using <u>purchasing power parity exchange rates</u>.

Offical (or market) exchange rates measure the price of one countries currency in terms of another. This price reflects currency exchanges that take place in order to buy or sell internationally– traded goods and financial assets. The PPP exchange rate measures the relative cost of the same representative basket of goods in two countries. This includes both internationally traded and non–traded goods and services. In fact, contrary to the statement above, the rise in Xanadu's GNP measured in US$ using official exchange rates will be *overestimated* relative to that measured using PPP exchange rates. The increase in exports will drive up the value of Xanadu's currency in terms of US$ since foreigners need to buy it in order to buy the manufactured good. The rise in the contribution of the export sector to Xanadu's GNP is the true increase in GNP here. However, because of the rise in the official exchange rate, the US$ value of the non–traded goods goes up as well even though there is no change in production. Consequently, the rise in GNP measured at the official exchange rate is greater than the true increase. Notice that comparing Xanadu before and after the change is analogous to comparing an LDC to a more developed country — at official exchange rates the gap between them is exaggerated.

A2. Using the World Bank's dollar-a-day poverty line, <u>poverty</u> has declined world– wide over the last 20 years. However, if we exclude China from such calculations, the picture looks very different.

1

Poverty is usually defined either as the absolute number or the percentage of people in a country below a specified income level (the headcount index). Note that there are, however alternative (and arguably better) ways to define poverty such as the poverty gap – the amount of money needed to move people below the poverty line up to it. Although, many countries have their own poverty line, the World Bank has introduced the use of the dollar a day ($US 370 per year) poverty line in order to maintain international comparability. Recently, this international poverty line has been raised to $1.25 per day, although many observers believe it should be higher.

Information regarding these poverty measures in various countries can be acquired from the World Bank, the UNDP and other sources. The table below is from Global Issues and summarizes some World Bank figures.[1] As it shows, the percentage of people in the world living below $1 per day (the bottom line in the graphs) fell from about 35% in 1980 to 14% in 2005. However, if China is excluded this decline was much less dramatic, falling from 23% to 16%. If we use other poverty lines (e.g. $2.50 per day – the top line in the graphs), the decline in poverty excluding China has been even less. These figures reflect two key facts: (1) China experienced a huge decline in poverty during this period, falling from 85% to 15.9%, or by over 600 million people, and (2) the poor population of China represents a large fraction of the world's poor. Note finally that, while the percentage of the world's population living in poverty has declined, the absolute number as hardly changed, currently estimated at 1.4 billion. This reflects the fact world population growth has been concentrated amongst poorer regions.

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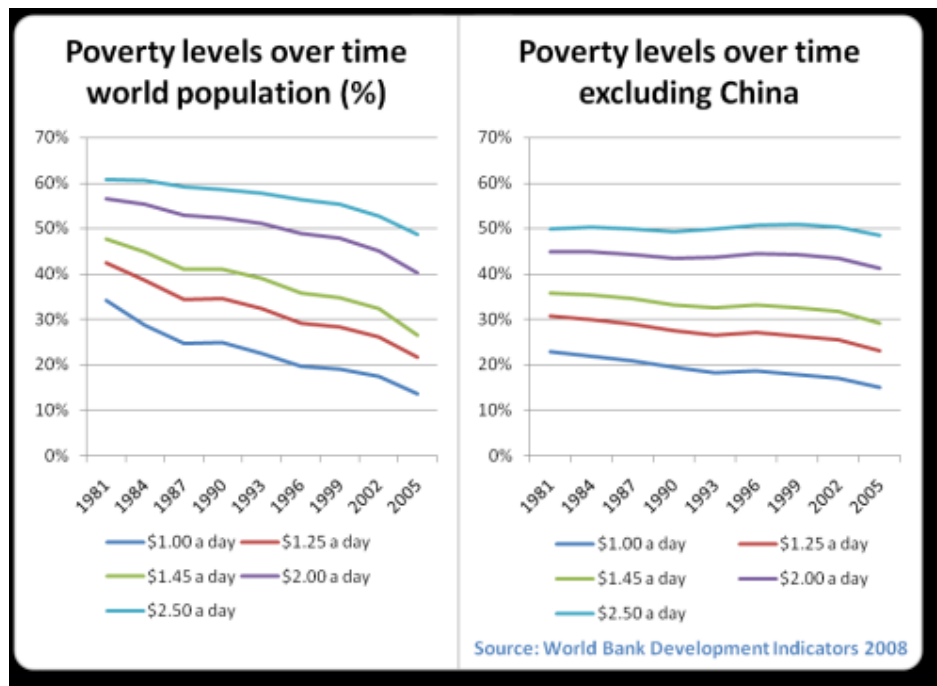
[1]See http://www.globalissues.org/article/4/poverty-around-the-world. This data does not cover the period reflecting the recent global food crisis and rising cost of energy.

A3. Economic transactions between people that take place over a period of time are likely to involve some kind of <u>asymmetric information.</u>
A situation of asymmetric information is one in which one party tgo a transaction has more or superior information compared to another. Potentially, this could be a harmful situation because one party can take advantage of the other party's lack of knowledge. There are two types of asymmetric information: (1) moral hazard (hidden actions) – where one party can take actions that have efficiency consequences, but are not observable – and (2) adverse selection (hidden information) – where one party possesses knowledge about the conditions of demand, technology, or costs that other parties do not have and cannot learn.

Transactions that take place over a period of time often involve some kind of asymmetric information, especially moral hazard. Consider the example of a farmer who borrows from a moneylender in order to finance an investment in working capital. This transaction takes place over time since the repayment (with interest) occurs at a later date. In the time between the loan and repayment, the lender can't control what the borrower does with the money, and in particular, cannot control the risks taken by the farmer. If the actions taken by the farmer (which affect these risks) cannot be observed by the lender they cannot be written into the debt contract up front: this is a situation where these hidden actions may lead to a moral hazard problem. Another example would be an insurance contract for a bike. In the period, between paying the insurance premium and potential making a claim, the insurance company may not be able to observe actions taken by the bike–owner that may affect the probability of the bike being stolen (e.g. buying a cheap versus effective bike lock).

A4. The <u>Harrod–Domar model</u> is a simple, but useful guide for assessing the likely impact of foreign aid on the <u>economic growth</u> of an economy (see Easterly, ch. 2, "Aid for Investment").
The Harrod–Domar model is a formal theory that offers a simple formula stating at what rate an economy must save, s, in order to attain a per capita income growth rate of g, given a population growth rate, n, a rate of physical depreciation, δ, and a capital–income ratio, v:

$$s = v(n + g^* + \delta).$$

Foreign aid can then be thought of as an attempt to fill the gap between this target savings rate and the actual savings rate of the economy. If the actual level of domestic saving is S^D and aggregate income is Y, the aid needed to achieve the target above is assumed to be given by

$$A = sY - S^D = v(n + g^* + \delta)Y - S^D$$

By "economic growth" we usually mean the annual percentage change in real (adjusted for inflation) gross national income (GNI) per person in a given country.

In principle, the Harrod-Domar model does provide a guide for assessing the impact of foreign aid on investment and, in turn, on an economy's growth rate. In practice, however, this model

has done a very poor job of predicting the effects of foreign aid on growth (as discussed by Easterly). Firstly, the impact of aid on investment in many countries has been small — much of the aid has been consumed in one way or another, rather than invested in growth–promoting activities. The assumption that aid will be simply added to domestic saving in order to raise investment, rather than substituted, ignores key incentives and institutional factors that have turned out to be important. Secondly, the statistical relationship between investment and growth over shorter periods has also been rather weak. In addition, to these practical problems, several key assumptions of the model are inconsistent with observed facts. In particular, the model implicitly assumes that there are constant returns to capital, and that there is surplus labour available. As Easterly argues, neither assumption is valid, at least in the long run.

A5. Countries A and B have the same rates of investment, population growth and depreciation. They also have the same levels of income per capita. Country A has a higher rate of growth than does country B. According to the <u>augmented Solow model</u>, it follows that Country A has the highest investment in human capital.

The augmented Solow model builds on the basic Solow model by allowing for the average human capital of workers to vary across countries. Typically, this human capital is an index based on differences in the average education of the work force. Specifically, the aggregate production function is represented by

$$Y = F(K, hL)$$

where h denotes human capital per worker. In per capita terms, this is expressed as

$$y = f(k, h).$$

As in the basic Solow model, increments to the capital stock per worker are given by the difference between the savings per workers and the break-even level of investment:

$$\Delta k = sf(k, h) - (n + \delta)k.$$

The steady state occurs at k^*, the value of k such that $\Delta k = 0$:

$$sf(k^*, h) = (n + \delta)k^*.$$

If there is zero technical change then, under the conditions stated, country A must have higher human capital per worker than country B. To see this note that the growth in the capital stock per worker is given by

$$\frac{\Delta k}{k} = s\frac{y}{k} - (n + \delta).$$

For a given level of h, the faster k grows, the faster y will grow.[2] If country A grows faster than B then, since s, n and δ are all the same, it follows from the above equation that the output–capital ratio in country A must exceed that in country B:

$$\frac{y_A}{k_A} > \frac{y_B}{k_B}.$$

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[2] If the growth rates differ, the countries cannot be at their steady-states.

As Figure illustrates, if income per worker is the same in both countries $y_A = y_B$ this can only be true if $h_A > h_B$. It shows the production functions for the two countries and the level of output. The slopes of the rays from the origin are the output capital ratios associated with that level of output. If the slope of this ray is higher for country A, it must be the case that it has a higher production function which can only stem from having higher human capital.
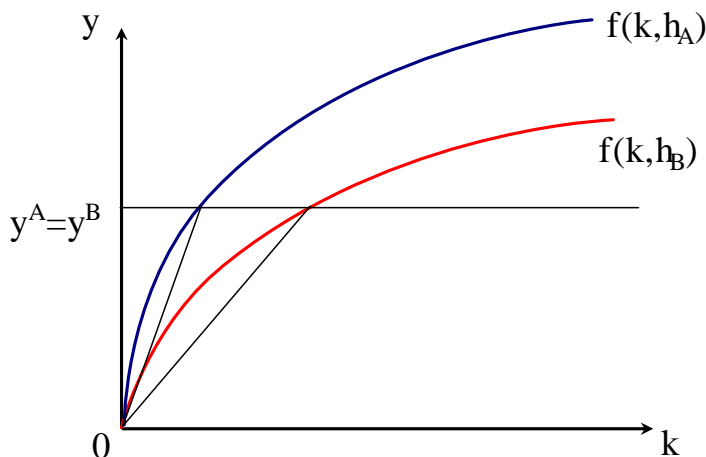
Section B (60 percent): Answer the following questions. They all have equal value.

B1. Suppose there are only two goods produced in the world: DVDs, which are traded internationally, and hair cuts, which are not. Assume that transport costs are negligible. The following table shows information on the production and prices of DVDs and hair cuts in the USA and China:

Country	DVDs Produced per Capita	Hair Cuts Produced per Capita	Price of DVDs in Local Currency	Price of Hair Cuts in Local Currency
USA	9	4	2	4
China	3	4	10	10

(a) What is the implicit market exchange rate between the currencies of the two countries?

Since DVDs are the only traded good in this example and there are no barriers to trade by assumption, the exchange rate must be such that the value of a DVD is the same in each country. Otherwise, there would be an opportunity to profit from trade, which would cause the exchange rate to adjust until this is true. It follows that the exchange rate is

$$2 \text{ US\$} = 10 \text{ RMB}$$

$$1 \text{ US\$} = 5 \text{ RMB}.$$

5

(b) Calculate the ratio of GDP per capita in the USA to GDP per capita in China in US dollars, using the market exchange rate?

US GDP per capita:

$$(9 \times 2) + (4 \times 4) = 34$$

Chinese GDP per capita in RMB:

$$(3 \times 10) + (4 \times 10) = 70$$

Converting into US\$ (at market rates):

$$70 \times \frac{1}{5} = 14.$$

It follows that the ratio is

$$\frac{\text{US GDP per capita (US\$)}}{\text{Chinese GDP per capita (US\$)}} = \frac{34}{14} = 2.43$$

(c) Use the US basket of goods to calculate a purchasing power parity (PPP) exchange rate between the two currencies.

To buy the US basket (9 DVDs and 4 haircuts) in China would cost

$$(9 \times 10) + (4 \times 10) = 130 \text{ RMB}$$

So the PPP exchange rate (using the US basket) is

$$34 \text{ US\$} = 130 \text{ RMB}$$
$$1 \text{ US\$} = 3.82 \text{ RMB}$$

(d) Now use the world basket of goods to compute an alternative PPP exchange rate.

To buy the world basket (12 DVDs and 8 haircuts) in the US would cost

$$(12 \times 2) + (8 \times 4) = 56 \text{ US\$}$$

In China this basked would cost would cost

$$(12 \times 10) + (8 \times 10) = 200 \text{ RMB}$$

So the PPP exchange rate (using the World basket) is

$$56 \text{ US\$} = 200 \text{ RMB}$$
$$1 \text{ US\$} = 3.57 \text{ RMB}$$

(Note that for this calculation it does not matter whether we use the whole world basket or half the world basket (6 DVDs and 4 haircuts), as long as we use something proportional to the world basket.)

(e) For each of the exchange rates in (c) and (d), compute the associated ratio of GDP per capita in the USA to GDP per capita in China in US dollars, using the PPP exchange rate?

Using (c) to convert the actual Chinese GDP into US$ gives us

$$70 \times \frac{1}{3.82} = 18$$

and so the ratio is

$$\frac{\text{US GDP per capita (US\$)}}{\text{Chinese GDP per capita (US\$)}} = \frac{34}{18} = 1.89$$

Using (d) to convert the actual Chinese GDP into US$ gives us

$$70 \times \frac{1}{3.57} = 19.6$$

and so the ratio is

$$\frac{\text{US GDP per capita (US\$)}}{\text{Chinese GDP per capita (US\$)}} = \frac{34}{19.6} = 1.73$$

Clearly both methods of computing the PPP rate reduce the measured income disparity between the US and China. This is because the fraction of Chinese GDP that comes from goods which are non–traded is larger than in the US (this is generally true in reality). The two methods for computing PPP rates yield different degrees of income disparity (using only the Chinese basket would give a third ratio). There is no "correct" method for computing PPP rates in this example, so the best we can do is consider the range of values that we get.

B2. The following income distribution data are for Brazil. The population is 150 million.

Quintile	Percent share
Poorest 20%	2.4%
Second quintile	5.7%
Third quintile	10.7%
Fourth quintile	18.6%
Richest 20%	62.6%
Richest 10%	46.2%

(a) On graph paper, carefully plot the Lorenz curve, labeling the axes.
The Lorenz curve plots the following points:

7

Percentile (%) (x-axis)		20	40	60	80	90	100
Share of Income (%) (y-axis)		2.4	8.1	18.8	37.4	53.8	100

It is illustrated by the curve in the attached figure which furthest to the right.

(b) Explain graphically how to find the Gini coefficient.

Its twice the area above the Lorenz curve and below the 45° line, or the fraction of the area below the 45° covered by the Gini coefficient. This area could be computed by adding up the areas of triangles and rectangles making up this area.

(c) Brazil's national income is about \$300 billion. What is the approximate dollar income of the bottom 20% ? Bottom 40% ?

Bottom 20% get \$7.2 billion. The bottom 40% get 24.3 billion.

(d) Suppose that each household makes the average income for its quintile. What is the level of poverty (measure by the headcount index) if the poverty line is \$400 per capita ?

The bottom quintile get \$240 each which is below the poverty line. All other quintiles are above the poverty line.

The headcount is 30 million or as a percentage it is 20%.

(e) Suppose ten percent of national income were transferred from the richest 20% of households to the poorest 20% of households. On the same diagram as in part (1), show the effect on the Lorenz curve.

Suppose the transfer comes from richest 10%. Each member of this group earns 0.462×300 billion/15 million = \$9240 each. The next richest 10% earns (0.626-0.462)×300 billion/15 million = \$3280 each. The transfer amounts to \$30 billion which is equal to \$2000 per head amongst the richest group, reducing their income to \$7240 each. Consequently, the richest 10% will continue to be the richest 10% after the transfer. The bottom 20% will receive a transfer of \$30 billion / 30 million =\$1000 each. Consequently they will no longer be the poorest 20% as their incomes rise to \$1240, which is more than the previous middle quintile who earn 0.107×300 billion/30 million = \$1070 each. It follows that the people who were originally in the second and third poorest quintiles move down to the first and second poorest quintiles, respectively, and the people who were in the poorest quintile move up to the middle quintile and have 10% more of the wealth. As a result, the coordinates of the new Lorenz curve are given by

Percentile (%) (x-axis)		20	40	60	80	90	100
Share of Income (%) (y-axis)		5.7	16.4	28.8	47.4	63.8	100

It is illustrated by the curve in the attached figure which is furthest to the left.
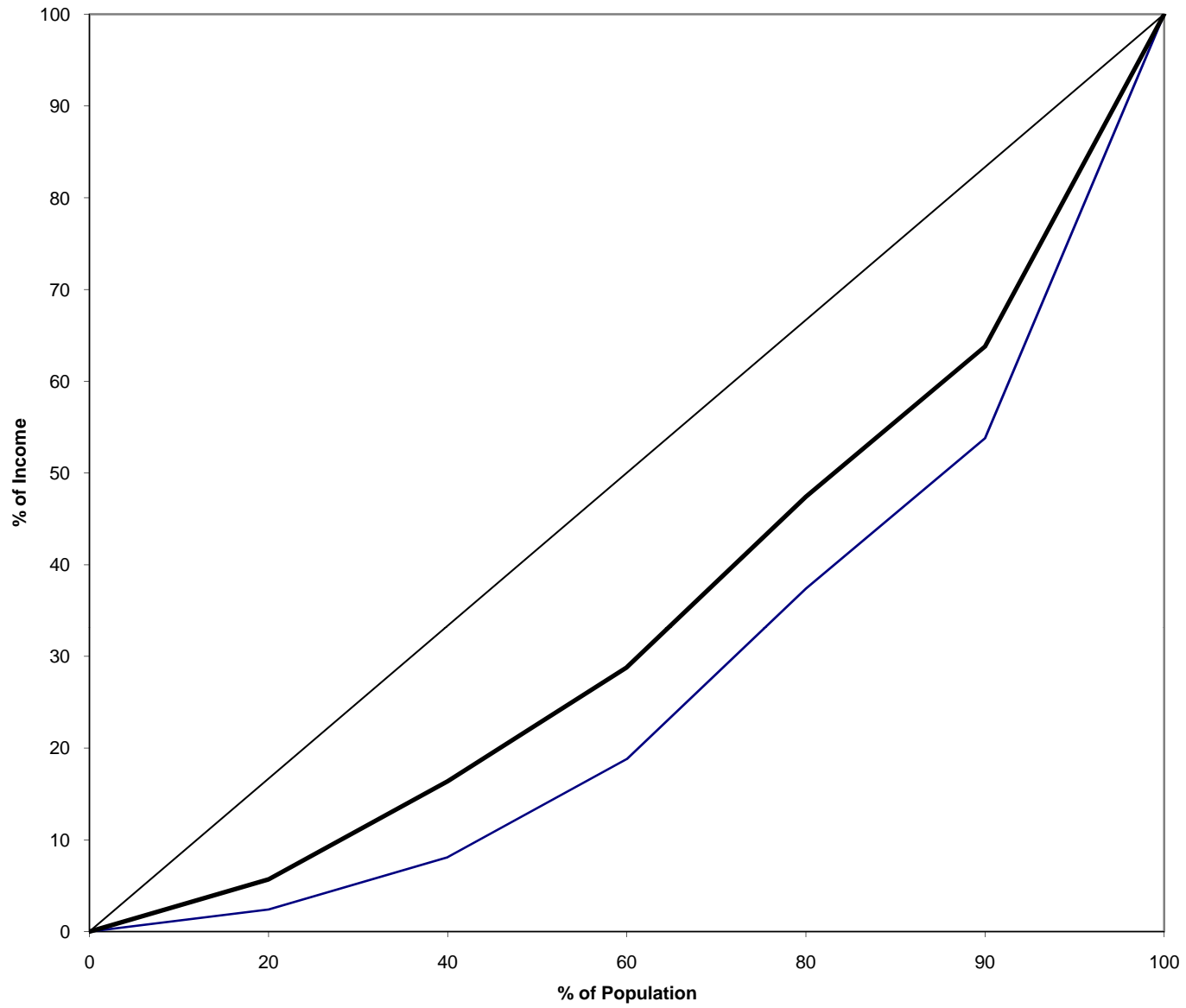
B3. Suppose a hypothetical economy can be well represented by a Solow model. The production function is estimated to be

$$Y = K^{\frac{1}{2}} L^{\frac{1}{2}}$$

where Y **represents output,** K **is capital and** L **is labour. The fraction of output invested each year is** $s = 0.25$**. The annual population growth rate is** $n = 0.02$ **and the depreciation rate is** $\delta = 0.03$**.**

(a) What are the steady state levels of capital per worker and output per worker?

In "per worker" terms, the production function can be expressed as

$$y = k^{\frac{1}{2}}.$$

The steady state level of capital per worker occurs when actual investment equals the break even level:

$$sk^{\frac{1}{2}} = (n + \delta)\, k$$

Solving for (a positive) k yields

$$k^* = \left(\frac{s}{n+\delta}\right)^2 = \left(\frac{0.25}{0.05}\right)^2 = 25$$

Substituting this back into the production function yields

$$y^* = \frac{s}{n+\delta} = \frac{0.25}{0.05} = 5.$$

(b) In year 1 the level of capital per worker is 16. In a table like the following one, show how capital and output change over time (the beginning is filled in as a demonstration). Continue this table up to year 8.

Year	Capital per worker	Output per worker	Investment per worker	Depreciation per worker	Change in Capital per worker
1	16	4	1	0.8	0.2
2	16.2	4.025	1.006	0.810	0.196
3	16.396	4.049	1.012	0.820	0.192
4	16.588	4.073	1.018	0.829	0.189
5	16.777	4.096	1.024	0.839	0.185
6	16.962	4.118	1.029	0.848	0.181
7	17.143	4.140	1.035	0.857	0.178
8	17.321	4.162	1.040	0.866	0.174

Investment per worker is $sk^{\frac{1}{2}} = 0.25k^{\frac{1}{2}}$. Depreciation per worker is $(n+\delta)k = 0.05k$. The change in capital per worker is $\Delta k = 0.25k^{\frac{1}{2}} - 0.05k$.

9

(c) Calculate the growth rate in output and capital per worker between years 1 and 2.

The growth rate in output per worker between years 1 and 2 is given by

$$\frac{\Delta y}{y} = \frac{4.025 - 4}{4} = 0.00625 \quad (\text{or } 0.625 \text{ \%})$$

The growth rate in capital per worker between years 1 and 2 is given by

$$\frac{\Delta k}{k} = \frac{16.2 - 16}{16} = 0.0125 \quad (\text{or } 1.25 \text{ \%})$$

(d) Calculate the growth rate in output and capital per worker between years 7 and 8.

The growth rate in output per worker between years 7 and 8 is given by

$$\frac{\Delta y}{y} = \frac{4.162 - 4.140}{4.140} = 0.0053 \quad (\text{or } 0.53 \text{ \%})$$

The growth rate in capital per worker between years 7 and 8 is given by

$$\frac{\Delta k}{k} = \frac{17.321 - 17.143}{17.143} = 0.0104 \quad (\text{or } 1.04 \text{ \%})$$

(e) Comparing your answers from parts (c) and (d), what can you conclude about the speed of output growth as a country approaches its steady state.

From (c) and (d) it appears that the speed of output growth (and capital growth) per worker declines as output per work increases towards its steady state. This is generally true in the Solow model and reflects that fact that there are diminishing returns to capital: as k increases, the increments to output and, hence, to changes in the future capital stock per worker, Δk, proportionally decline.