Macroeconomics Assignment 2 ECON 10003

Aditya Sarkar - 1354041
Wei Li - 1327516

Question 1

$$Y_t = AK_t \text{ and } A = 1$$

The key distinguishing factor in this scenario is that there are no diminishing marginal returns to capital input. Let's first convert the given production function into its intensive form:

$$Y_t = k_t \text{ where } k_t = \frac{K_t}{L_t}$$

While investment in capital is the active expenditure component of AD which grows capital, depreciation on the other hand is the passive decaying away of capital inputs. This relationship can be shown as below:

$$(1 + g_L)(k_{t+1} - k_t) = s{*}f(k_t) - (\delta + g_L)k_t$$
$$\text{In Steady State:}$$
$$\text{Let } (1 + g_L)(k_{t+1} - k_t) = 0$$
$$0 = s{*}f(k_t) - (\delta + g_L)k_t$$
$$s{*}f(k_t) = (\delta + g_L)k_t$$
$$s{*}k_t = (\delta + g_L)k_t$$
$$s = (\delta + g_L)$$
$$\text{i.e. investment} = \text{depreciation}$$

1. Thus, if the sum of the depreciation rate and the population growth rate is less than the savings rate we know that the economy cannot be in a steady state. In fact, the economy will never be in a steady state in this case. This is because there are no diminishing marginal returns and both investment and depreciation curves are thus straight lines. This means that investment will always be greater than depreciation. (see Figure 1.1) Investment per worker greater than depreciation per worker will mean that capital will grow which in turn will mean greater output per worker and greater investment (since investment is a proportion of output). Since there are no diminishing marginal returns, there will not be a point at which the depreciation of capital per worker will outweigh the gains of the new capital. In this case the amount of capital will blow out to infinity.

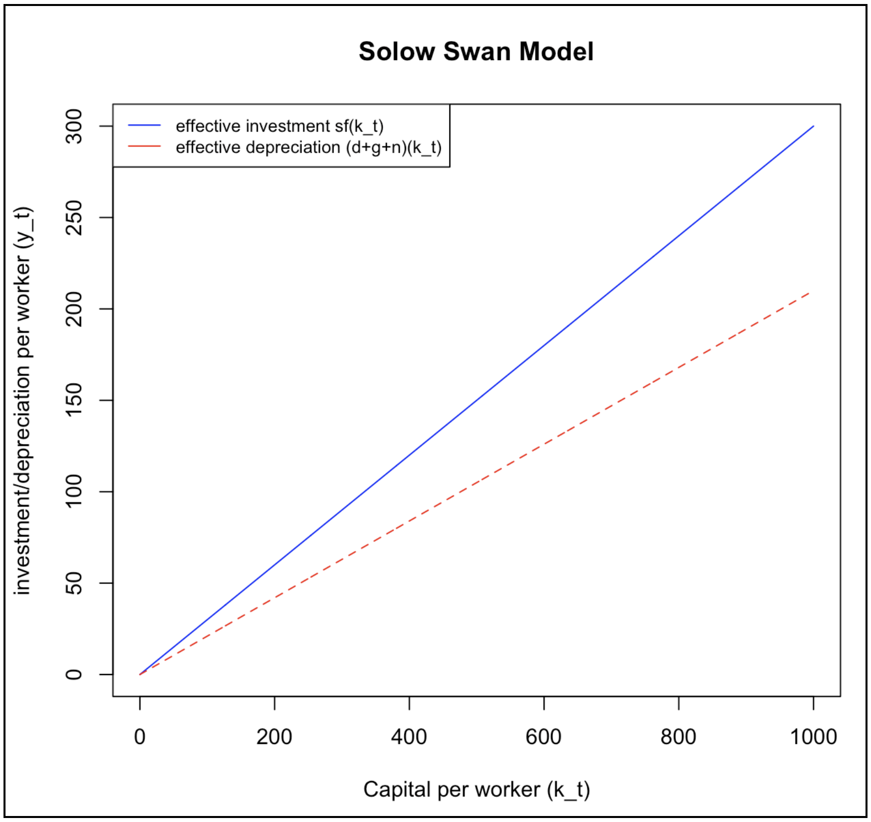

Figure 1.1 - $g + n < s$

2. In a similar way, if the sum of the depreciation rate and the population growth rate is greater than the savings rate, investment per worker will always be less than depreciation and thus the economy cannot be in a steady state. Investment lower than depreciation will mean decreasing capital, decreasing output and ultimately decreasing investment. In this case capital will decrease to 0. (see Figure 1.2)

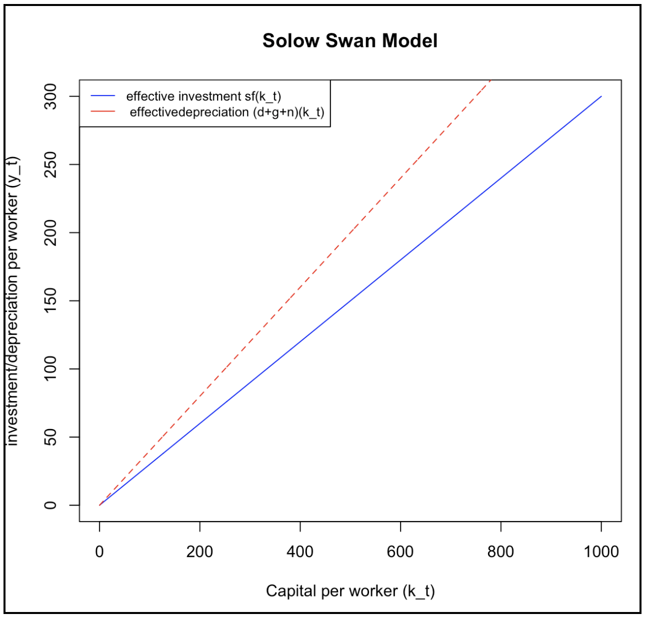

Figure 1.2 - $g + n > s$

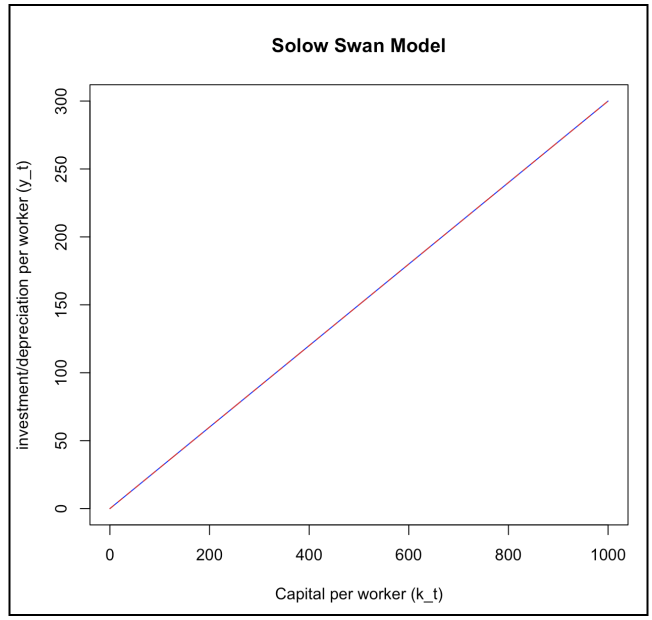

Figure 1.3 - $g + n = s$

3. Conversely, if the savings rate is equal to the sum of depreciation and population growth, the economy will always be in a steady state. Mathematically we can show that the investment curve and the depreciation curve is in fact the same line and therefore there are infinite solutions (see Figure 1.3). Thus, since investment is always equal to depreciation, there is never any economic force causing an increase or decrease in capital per worker. In this case the capital that the economy started with will be the capital that the economy stays with for the long term.

Diminishing marginal returns refers to the characteristic of production functions in which the amount of additional output generated by each additional unit of input decreases. i.e. The marginal product of capital decreases as more capital is added. The same applies for the marginal product of Labour. Let's consider a production function with diminishing marginal returns.

Consider a shock in which there is an increase in savings, (see figure 1.4). Mechanically, we can consider a money market where savings represent supply and investment represents demand. An increase in savings will mean that there is surplus capital (funds) and thus there will be an expansion in demand and a decrease in the interest rate. (Mankiw, 2019). This will mean that there is a new investment function which will be larger than the original, i.e. the investment curve shifts outwards (purple curve). Thus, since the economy is still at the old equilibrium, investment temporarily exceeds depreciation and capital begins to grow. This causes output to grow and in turn capital again. But as capital increases, since there are diminishing marginal returns, each additional unit of capital results in a smaller growth in output and thus investment in new capital. Thus the economy converges to the point at which depreciation exactly balances out the gains from new capital. Any more investment will not generate enough of an increase in output to balance of the extra depreciation due to the new capital.

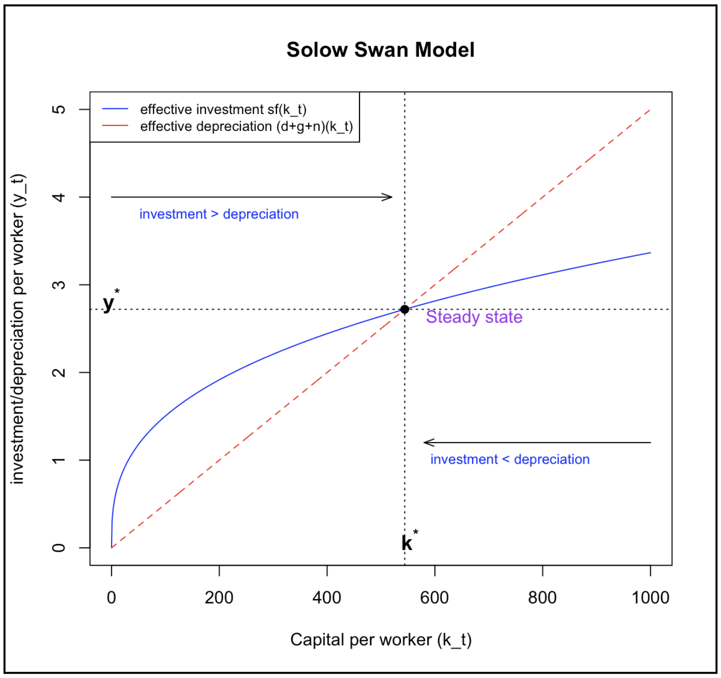

Figure 1.4 - Solow swan diagram with DMR

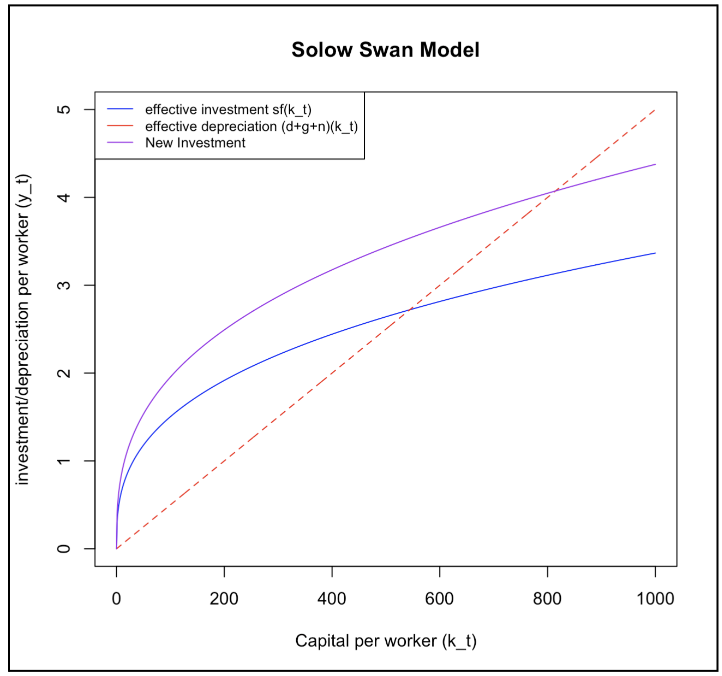

Figure 1.5 - Increase in savings

It is also important to note that because this is in 'per worker' terms total capital and total output can continue to grow over the long term even if output per worker is constant due to population (and productivity) growth. We can thus see that Kt* = kt*Lt. By converting to intensive form, the factor that grows over time (employment and by extension population) has become a factor of the model for total capital. This means that any steady states for k* which are constant equilibriums over time,(do not change over time) will then convert into a growth rate for K* determined by the growth in L, i.e. population growth. In this case, the shock causes an increase in growth in total capital which converges back to the original growth rate, but at a higher level than it otherwise would have been.

Question 2

Figures 2.1 through 2.4:

Plots have been produced in R.

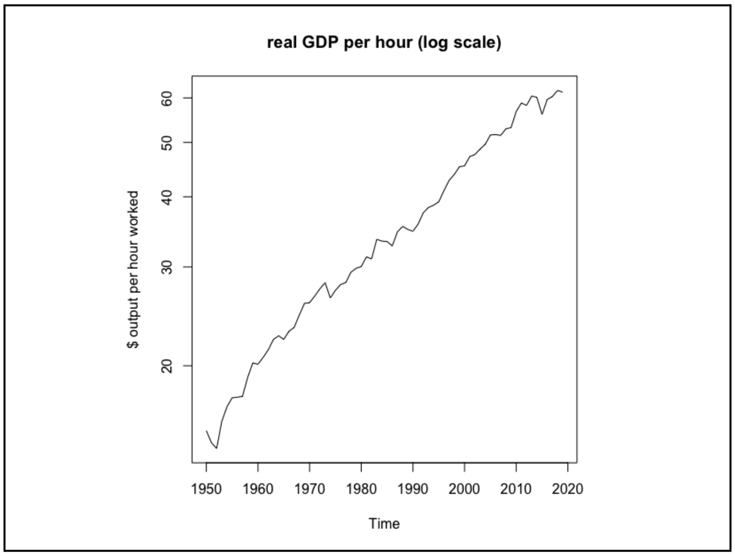

Figure 2.1

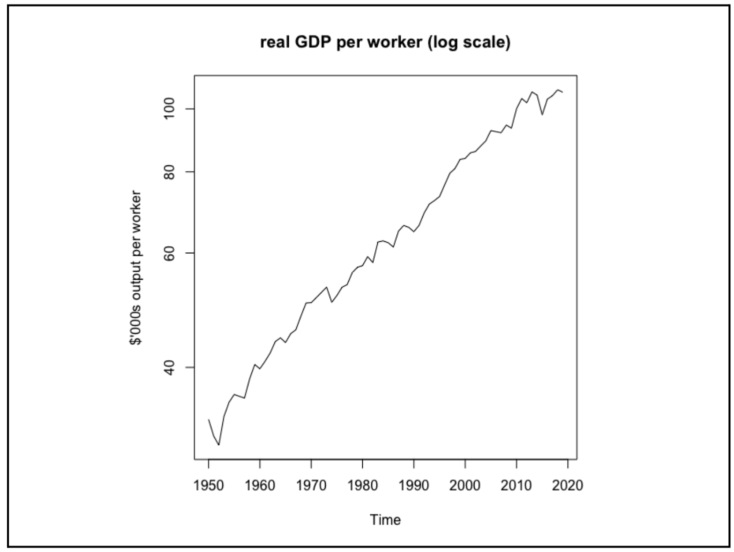

Figure 2.2

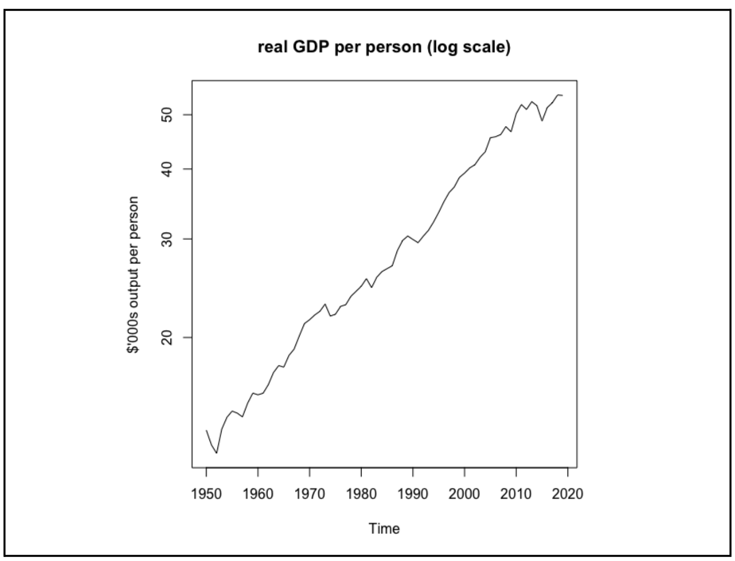

Figure 2.3

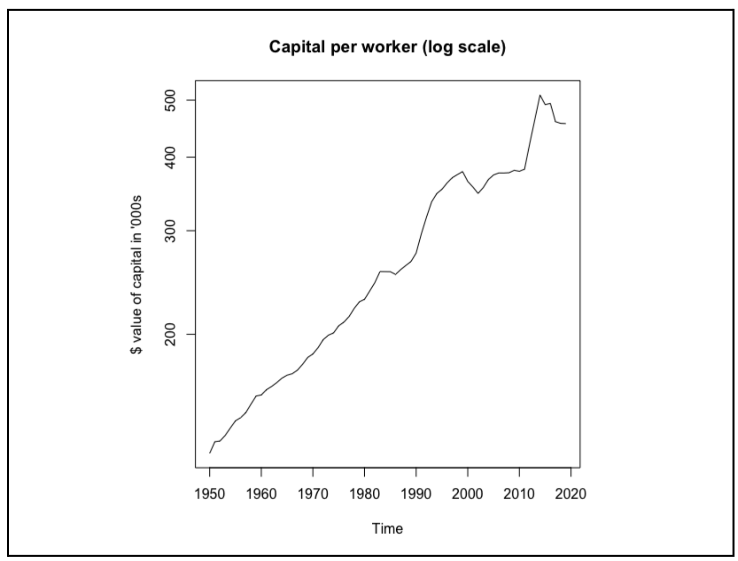

Figure 2.4

	Mean growth in real GDP per worker (%):	Mean growth in real GDP per person (%):	Mean growth in real GDP per hour worked (%):	Mean growth in capital per worker (%):
Total	1.74	2.06	2.08	1.93
50s	2.30	1.82	3.26	2.53
60s	2.23	2.93	2.49	1.52
70s	1.30	1.36	1.49	2.20
80s	1.47	2.33	1.66	1.60
90s	2.45	2.46	2.61	3.61
00s	1.12	1.91	1.63	0.07
10s	1.36	1.59	1.54	2.01

Table 1.1

To analyse the growth in labour productivity, we look at the annual average growth rate of real GDP per worker, real GDP per hour worked, and capital per worker as calculated above. It can be seen that the 50s and the 90s have the highest growth rates overall with output per hour worked growing by 3.26% in the 50s and capital per worker by 3.61% in the 90s. The main contributing factor of the strong growth in the 50s is the economic boom after WWII, driven by increased immigration due to changes in government immigration policies and a growing manufacturing industry (Copland, 1954). In the 1990s, growth in capital per worker came about through the rise of technology and the deregulation of industries such as telecommunication (Berger-Thomson et al., 2018). Conversely, growth in labour productivity slowed in the 2000s because of the 2008 Global Financial Crisis and the dot-com bubble, a stock market bubble crash (RBA, 2023). Fortunately, Australia did not suffer from a severe economic downturn, but there was stagnant growth as seen from the extraordinarily low growth in capital per worker of 0.07% in Table 1.1.

Mean growth in capital stock 1950-2019 (%):	Mean growth in employment 1950-2019 (%):	Mean growth in capital per worker 1950-2019 (%):
3.89	1.94	1.93 ~= (3.89 - 1.94)

Table 1.2

The Australian economy has become more capital-intensive over time as seen through the growth of capital per worker in Figure 2.4 and Table 1.2. Becoming more capital-intensive refers to having a higher growth in capital per worker relative to labour growth, which results in greater capital share. It is still important to note that although capital per worker is continuing to increase, the growth rate of capital per worker seems to have slightly decreased. There are many factors that contribute to increased capital intensity, a key reason being the shift of industries in the Australian economy from industries such as agriculture and manufacturing to services, which is inherently more capital-intensive (ABS, 2022). At the same time, advancements in technology not only made providing goods and services more efficient but also helped drive these capital-intensive industries. Further, the Australian government heavily invested in infrastructure post World War II, increasing capital intensity.

Appendix

R files can be found here:

Github Link

References

Australian Bureau of Statistics (September 2022). Structural change in Australian industries – insights from the KLEMS Multifactor Productivity 2019-20 dataset. ABS. https://www.abs.gov.au/articles/structural-change-australian-industries-insights-klems-multifactor-productivity-2019-20-dataset

Berger-Thomson, L., Breusch, J., Lilley, L. (October 2018). Australia's Experience with Economic Reform. https://treasury.gov.au/sites/default/files/2019-03/p2018-t332486-economic-reform-v2.pdf

Copland, D. (1954). The Australian Post-War Economy: A Study in Economic Administration. The Canadian Journal of Economics and Political Science, 20(4), 421-428. https://doi.org/10.2307/138553

Feenstra, R. C., Inklaar, R., & Timmer, M. P. (2015). The next generation of the Penn World Table. *American Economic Review*, 105(10), 3150-3182. Retrieved from www.ggdc.net/pwt

Mankiw, N. G. (2018). Principles of Economics (8th ed.). Cengage Learning.

Mishkin, F. S., & Serletis, A. (2019). The economics of money, banking, and financial markets (6th ed.). Pearson.

Parkin, M. (2018). Macroeconomics (13th ed.). Pearson.

Reserve Bank of Australia. (2023). Statement on monetary policy – Feb 2023. https://www.rba.gov.au/publications/smp/2023/feb/

Reserve Bank of Australia. (2023) The Global Financial Crisis.

https://www.rba.gov.au/education/resources/explainers/the-global-financial-crisis.html

Salla R., MacGregor D., Grinham T. (2021). Economic Fundamentals in Australia (7th edition), Commerce Presentations & Publications

The Economist, (2023). Policymakers face two nightmares: stubborn inflation and market chaos. https://www.economist.com/finance-and-economics/2023/03/23/policymakers-face-two-nightmares-stubborn-inflation-and-market-chaos